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HORMONE SPRAYS AND THEIR EFFECT UPON THE KEEPING QUALITY OF BARTLETT PEARS

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HORMONE SPRAYS AND THEIR EFFECT UPON THE KEEPING QUALITY OF BARTLETT PEARS¹

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INTRODUCTION

APPLICATIONS of plant-growth-regulating substances such as α -naphthaleneacetic acid and α -naphthaleneacetamide, commonly known as hormones, have been found to delay somewhat, in several species, the normal abscission of certain plant organs (blossoms, fruit, and leaves). In 1939, workers in the United States Department of Agriculture⁴ utilized this property to reduce the serious losses that premature dropping often causes in the apple crop, especially of certain varieties. Not only was much fruit saved that would otherwise have dropped, but both color and dessert quality were improved by delaying the harvest until the fruit was properly mature.

Learning of these good results with apples, pear growers on the Pacific Coast immediately began to use the hormone sprays to effect a possible saving in the pear crop. In 1940 and in 1941 the California Agricultural Experiment Station and the United States Department of Agriculture⁵ jointly experimented in the Santa Clara Valley and in Lake County to determine the extent of the normal drop, both before and during the harvest period, and the effectiveness of the sprays.

The studies showed that even with a moderate amount of dropping, applications of the hormone material, included in the cover sprays, were justified. In the Santa Clara experiments the rate of drop increased toward the end of the picking season; the savings effected by the spray application therefore increased as the season progressed. Observations in other districts, some of which are subject to strong winds during or just before harvest, strongly indicate that the use of the hormone saved even more of the crop than in the Santa Clara Valley. The general results secured by numerous growers who used such sprays were likewise so marked that since 1942 the addition of hormone material to the last cover spray has become standard practice.

PRELIMINARY TRIALS AND OBSERVATIONS

In the 1940 and 1941 experiments of the Station with pears, no effect of the hormone sprays upon fruit maturity was observed at harvest, and none was reported later by the coöperators or by the canners to whom the fruit was delivered. These observations agree with those reported by investigators who conducted maturity and storage tests with apples.

During the past few seasons, however, canners, shippers, and storagemen alike began to experience considerable loss in various lots of Bartlett pears,

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⁴ Gardner, F. E., P. C. Marth, and L. P. Batjer. Spraying with plant-growth substances to prevent apple fruit dropping. *Science* 90:208-09. 1939. *Also*: Spraying with plant-growth substances for control of the preharvest drop of apples. *Amer. Soc. Hort. Sci. Proc.* 37: 415-28. 1939.

⁵ Davey, A. E., and C. O. Hesse. Experiments with sprays in the control of preharvest drop of Bartlett pears in California. *Amer. Soc. Hort. Sci. Proc.* 40:49-53. 1942.

either upon arrival in the eastern markets or after a brief storage period. This loss, together with actual ripening and breakdown while the pears were still on the trees, suggests that the use of the hormone sprays is detrimental to the keeping quality.

In 1942 a severe type of watery breakdown was observed in Lake County pears after 6-weeks' storage. The same condition was noted, by one of the present writers, in Oregon pears sent to California for canning; and losses were reported in shipments of Sacramento River pears.

In all these, and in similar instances where the history of the fruit could be obtained, the trouble appeared to be closely associated with overmaturity at harvest. The ease with which the pear stems separate from the spur, and the concurrent dropping, are definite indications of maturity. When this normal dropping is delayed or prevented by the hormone sprays, Bartlett pears continue to ripen rapidly, and a week or 10-days' delay in harvesting may easily mean some overmature fruit—in fact some yellow, soft pears on the tree. Confronted with a large crop and a labor shortage, growers have sometimes used the hormone sprays to lengthen the normal picking season. As clearly demonstrated by the results of the past year's tests, this undue delay in harvesting greatly impairs the keeping quality.

Preliminary storage trials with pears and apples were made in 1942. In 1943, additional observations were made with Bartlett pears from adjoining blocks of hormone-sprayed and unsprayed trees in 6 orchards: 1 at Courtland; 2 at Fairfield; 1 each at Davis, Placerville, and Kelseyville. All fruit was harvested before midseason (Courtland, July 19; Fairfield, July 20; Davis, Placerville, and Kelseyville, August 2, 6, and 9 respectively), packed, and placed in cold storage the same day as picked. Holding periods were 10 to 40 days at 45° F and 6 to 20 weeks at 32° F. Relatively little trouble was observed in any of these lots even after extended storage, or until several days later when the fruit was ripe. These preliminary storage trials failed to show any definite or consistent effects of the hormone sprays. The results further supported the view that the breakdown previously observed was due to overmaturity or to faulty handling after harvest. Unfortunately, from the standpoint of these tests, fruit was harvested at only the one stage of maturity and was afterward handled only under optimum conditions.

Uneven ripening and premature breakdown, both in storage and during subsequent ripening, have continued, however, to be observed; the canners in particular suffered some severe losses. For this reason the Canners League of California requested the Division of Pomology of the College of Agriculture to study the problem more comprehensively and in greater detail during the 1944 season.

OUTLINE OF TESTS MADE IN 1944

The 1944 trials were planned in coöperation with the operating committee of the Canners League and with H. K. Wilder of the National Canners Association. The experiments called for comparisons as outlined below:

Two treatments: sprayed with hormone, and not sprayed with hormone.

Three localities: Sacramento River district, Santa Clara Valley, and Lake County.

Three pickings: early-canning maturity, midseason maturity, and the late-canning maturity.

Two sizes of fruit: large pears ($2\frac{3}{4}$ to 3 inches) and medium pears ($2\frac{1}{2}$ to $2\frac{5}{8}$ inches).

Delay in storage: 1 day and 3 days.

Holding periods: with shipping fruit, 12 days at 45° F; with storage and canning fruit, 40 days at 32° F, and 60 days at 32° F.

In short, as shown above, the comparisons were intended to supply information upon the possible effects of hormone sprays as influenced by: (1) growing conditions in different districts, (2) maturity of the fruit at harvest, (3) sizes at harvest, (4) delay in cooling after harvest, and (5) the temperature and length of the storage period. After storage half of the fruit was subsequently ripened at Davis and half at San Jose before being canned. Some samples were also sent to San Jose to be ripened and canned without undergoing storage.

SELECTION OF DISTRICTS AND ORCHARDS

Because of the interest of the canning industry, the experiments were conducted in two districts that produce canning pears in largest volume—namely, the Santa Clara Valley and the Sacramento River. The third district, the Clear Lake area of Lake County, was included because in normal years the pears were usually left on the trees longer than in most other pear regions, and especially because breakdown had been serious in certain lots of pears in storage and after transit to eastern markets. Data were collected from the several districts because of known differences in ripening and keeping quality of the fruit. Plots were selected in a single orchard in each district, and the observations included two trees in a second orchard in Lake County. The orchards selected were typical of the district and were situated as described in the paragraphs that follow.

Sacramento River.—The study was made in a fifty- to sixty-year-old orchard, operated by Donald C. McClain, a mile or so above Courtland. The plots were several hundred yards from the levee. Sprayed and unsprayed plots consisted of 11 trees each. For the late-canning and cleanup pickings, however, the number of trees sampled was reduced to 3 in each plot to avoid wastage of fruit. The plots were separated by a north-south service road, and about half the trees in each plot bordered on this road. Within the plots the branches of adjacent trees touched. Clean cultivation was practiced, and the trees received two irrigations—one the first week in June, the other about July 10.

Santa Clara Valley.—Tests were made in an orchard twenty-six years old, owned by Walter G. Brown near San Jose, on First Avenue about a mile north of the Bay Shore Highway. The sprayed plot contained 20 trees; the unsprayed plot, 16. These formed a block within the orchard, and there were no border trees. Pears for the late-canning picking were taken, for reasons of economy, from single sprayed and unsprayed trees. The trees in this orchard were smaller than those in the other districts, but were sufficiently large so that a 10-foot ladder was necessary for the pickers to reach the tops. Branches usually did not extend across the rows. Most of the trees had satisfactory crops, and some were heavily loaded. The orchard was clean cultivated, and the plots received two irrigations—the first in early June and the second on July 10.

Lake County.—Of the two orchards studied in this county, one, fifty years old, was owned by Herbert Rogers and was situated on Kelsey Creek not far from Kelseyville on the highway to Lakeport. Plots were of 3 trees each, bordering on a service road. The trees had filled in between the rows. The crop was very good, and all the trees were well loaded. A permanent covercrop was maintained, and fertilizer applied. Because of the covercrop, irrigations were given once a month from May to September inclusive, with an extra irrigation in July.

The second orchard was an old one owned by J. L. Annette, less than a mile from Finley. Single sprayed and unsprayed trees furnished the fruit for all pickings. These trees were large and well loaded. They were evidently survivors of an old planting and stood about 100 feet apart, with competition only from replants. Thus they were practically growing in the open. The orchard was clean cultivated and was irrigated once during the first two weeks of July.

The orchards were similar in three respects: all were on French root; all were irrigated at least once during the summer before harvest; and all bore satisfactory crops.

In each orchard the trees in the sprayed and unsprayed plots were closely comparable in type and situation.

HORMONE SPRAY APPLICATIONS

As used in this report, the terms *sprayed* and *unsprayed* refer only to the application and withholding of hormone materials. In practice, the hormones are added to the late cover spray of lead arsenate against codling moth; and thus the unsprayed trees, besides having no hormone application, had one less cover spray of arsenate. Any possible difference in results that might be attributable to hormone preparations of different manufacture, have been disregarded in this report.

The materials used by the several operators were as follows:

On the Sacramento River plot, $\frac{1}{2}$ pound of proprietary hormone per 100 gallons of spray, with 4 pounds of standard lead arsenate, spreader, and 3 quarts of light oil. The date of application was July 7, and 18 days elapsed before the beginning of harvest.

On the Santa Clara plot, $\frac{1}{2}$ pound of another proprietary hormone preparation per 100 gallons of spray, with 2 pounds of standard lead arsenate and 1 pint of oil spreader. The spray was applied on July 24 and harvest started 10 days later.

On the Kelseyville plot, $\frac{1}{2}$ pound of the same hormone preparation used at Santa Clara was added to every 100 gallons of spray, with 4 pounds of standard lead arsenate and 1 quart of spreader. The date was August 3; picking started 7 days later.

On the Finley plot, 1 pint of a third hormone preparation was added to every 100 gallons of spray, applied with lead arsenate about August 1, a week before harvest.

The length of the period between the application of hormone and the harvest may be important. In the opinion of some investigators, sprays applied too early may promote breakdown.

SELECTION AND HANDLING OF FRUIT

As stated previously, the plan called for three pickings from each of the three districts. In practice, however, two additional pickings were made from the McClain orchard at Courtland on the Sacramento River. The first of these, on July 17, was 7 to 10 days after eastern shipment began, and a similar length of time before the fruit first began to move to the canneries; the other was a late, or cleanup picking on August 21. These five pickings afforded a comparison of the fruit practically throughout the picking season. Harvest dates of the three main pickings for the different districts were as follows:

| | <i>Early canning</i> | <i>Midseason canning</i> | <i>Late canning</i> |
|-------------------------|--------------------------|------------------------------|-------------------------|
| Sacramento River | July 25 | August 8 | August 15 |
| Santa Clara Valley..... | August 3 | August 17 | August 28 |
| Lake County | August 10 | August 24 | September 7 |

At each picking, fruit was taken from all parts of the tree. When picked and again when packed it was selected, as nearly as possible, for uniformity of size. As anticipated, there was difficulty in securing at every picking enough fruit of two distinct sizes, medium and large, for sampling. The number of samples of large fruit (above $2\frac{3}{4}$ inches in diameter) was therefore limited. Early pickings of medium-sized pears were $2\frac{1}{2}$ to $2\frac{5}{8}$ inches in diameter; later pickings, $2\frac{5}{8}$ to $2\frac{3}{4}$ inches. The cleanup picking included a few 3-inch pears, but (as a rule) scarcely enough to make separate samples. About 100 pears, or one shipping lug of fruit, constituted a sample. For uniformity of sampling, each lug box contained pears from different parts of several trees. All fruit which was damaged by codling moth, or which showed other serious defects was discarded.

Except for "hot" pears shipped directly to a packing company at San Jose, the entire picking of 25 to 30 boxes was taken to the University Farm at Davis for storage.

To measure maturity, each picking of sprayed and unsprayed pears was checked in the orchard for color development, firmness, and soluble solids. A standard chart was used for color comparison, a pressure tester with a $\frac{5}{16}$ -inch plunger point for determining firmness, and a Zeiss hand refractometer for ascertaining the soluble solids.

SIMULATED SHIPPING TESTS

To simulate shipping conditions, box-lot samples of fruit were placed in a 45° F storage room the day following harvest and allowed to remain there for 12 days. Then each lot was removed, and the fruit inspected for ripening changes and for its general condition. The results are shown in detail in table 4.

COOLING AND STORAGE PROGRAM

Except for the "hot" pears which were ripened and canned without any storage period, all fruit was cooled and held in the experimental cold-storage plant at Davis. Regular storage lots were held at 32° F and the shipping lots at 45°. To simulate commercial handling of large lots, the experimental samples were purposely held out of storage at 75° to 85° for 24 and also for

72 hours after picking. Since a few hundred boxes of fruit in a storage room having good air circulation and a temperature thermostatically controlled at 32° would cool much more rapidly than large blocks of fruit in commercial storage, the rate of cooling was likewise purposely slowed down. Where commercial storage rooms are heavily loaded, or warm fruit is added daily, or there is little air movement, or air temperatures may run considerably above 32°, previous investigations have shown that 6 to 8 days may be required for removing the heat from the fruit in the center of some boxes. Moreover, regardless of the temperature of the room, the final fruit temperatures in the center of the box are usually 1 to 2 degrees above that of the surrounding air. In the experiments, therefore, 6½ to 7 days were spent in reducing the fruit temperature at the center of the boxes to 32° or 33°. These temperatures and rate of cooling over the entire cooling period were recorded by thermographs.

In accordance with the outline, concomitant lots of fruit were held for 40 and for 60 days before being removed for observation, ripening, and canning. All lots stored were in duplicate: one, ripened at 65° F, was observed at Davis; the other, when removed from storage, was shipped immediately by express to San Jose for ripening and canning.

Upon removal from storage, each lot was observed for any color change that might have occurred. Samples were again used for pressure testing and for determining any changes in soluble solids. The fruit was inspected for differences in ripening or evidence of breakdown. Additional observations were made daily, and ripening and breakdown data were recorded on the day the pears were considered ready for canning and also when the fruit generally had become too ripe for use.

CANNING PROGRAM

The lots of fruit shipped to San Jose usually arrived within 24 hours and were ripened at atmospheric temperature—70 to 80° F. After being observed for time and uniformity of ripening, 40 of these lots were canned under expert direction. They were later stored for subsequent inspection to determine whether the sprayed and the unsprayed pears responded differently to processing, and how the canned sprayed and unsprayed fruit compared in quality in relation to delayed and prolonged storage. Table 3 presents the results of those observations.

MATURITY CHANGES AND BREAKDOWN IN BARTLETT PEARS

In interpreting the results of the program just outlined, involving several factors that influence keeping quality, one must recognize certain well-established facts about the ripening and the normal keeping quality of pears. As the picking season progresses, the fruit normally assumes greater color, the flesh becomes less firm, and the soluble solids in the juice increase slightly. These same changes continue after harvest until the tissues finally succumb to physiological breakdown or fungous decay. All fresh fruit, therefore, regardless of inherent differences in keeping quality due to climatic or cultural conditions, possesses a certain "life span" during which time it is edible or has economic value. Each individual fruit goes through the overlapping stages of picking maturity, ripeness, and final deterioration.

Although not always distinct one from the other, and not always occurring separately, several different types or at least several different manifestations of breakdown are observed in Bartlett pears. While still normal externally, except perhaps for pear scald, the fruit may begin to break down inside. The flesh and the vascular strands running through it become slightly discolored, and the flesh has a dry, mealy texture resulting from separation of the individual cells. This common type of overripeness is known as *internal breakdown*.

Sometimes accompanying this condition, but often distinct from it, is a trouble involving only the flesh around the core. This flesh becomes brown, soft, and watery in contrast to the more general dry, mealy, internal breakdown, and is referred to as *core breakdown*. Pears produced in the cooler growing sections of California are particularly susceptible to core breakdown within 2 or 3 days after becoming ripe.

In contrast to these breakdowns, which occur internally, handling of ripe pears may easily cause *bruising* or *surface injury*. The affected area of skin and the flesh immediately beneath become soft and discolored. Often the skin separates easily from the flesh. Naturally, bruising hastens the general deterioration of the fruit.

A fourth condition, both external and internal, is *calyx breakdown*. Externally it is characterized by a small, brown area in the calyx cavity. Internally the flesh is sometimes soft; and when the fruit is cut this watery flesh may be seen surrounding the calyx tube and extending for some distance in toward the core. In the more advanced stages the whole core area becomes soft and discolored, and the entire flesh may become watery. Like the three types discussed above, this breakdown manifests itself only after the fruit has reached prime eating condition. The direct cause is not known, but the trouble is noticeably worse in some lots of fruit than in others.

The newest type to be recognized, and the one with which this report is primarily concerned, is *watery breakdown*. In appearance it is distinctive, and in economic value it is highly destructive. The trouble may have its inception deep within the tissues, but usually it is found near the surface—near the calyx end or on the neck of the fruit. At first it is characterized by irregular but well-defined water-soaked spots. These rapidly coalesce and involve all the tissues until, within 1 or 2 days, the entire fruit may become a “bag of water.”

According to all previous investigations, this type of breakdown, like the types described above, occurs only in overmature or in ripe fruit. It is usually distinct from other forms, however, in that a small part of the crop ripens quickly and becomes completely broken down, while most of the fruits are still hard and firm and possibly of green color. The breakdown of certain fruits may even be observed before picking. From the economic standpoint, however, the problem becomes serious and most important when, after fruit of *apparent* uniform maturity is picked or stored, it is ripened or removed from refrigeration with one or more pears in each box completely soft and watery. This condition may occur within 30 days at 32° F or within 10 to 14 days at a shipping temperature of 45°. Besides this rather spontaneous destruction of certain pears while others are still good, wateriness may accom-

pany other forms of breakdown after the fruit as a whole passes prime eating condition.

Refrigeration, because it retards the life processes that result in ripeness and breakdown, is important in delaying the transition of the fruit from one maturity stage to another. In this respect, temperatures near freezing are much more effective than those not so low; but even a minimum storage temperature for pears (29° to 30° F) cannot satisfactorily hold, for any considerable period, fruit which when first stored is already overmature or well advanced in its life span.

Basically, breakdown as characterized by a discoloration or a watery condition of the flesh is a manifestation of senescence or old age; both the stage of development, when the pears are harvested, and the degree of maturity when they are subjected to cold-storage temperatures are factors of the greatest importance to keeping quality. Bartlett pears that have reached maturity on the tree continue to ripen rather rapidly; and overripeness, with subsequent early breakdown, *can be avoided only by harvesting and cooling without delay*. Any orchard or handling practice that hastens the normal increase in coloring and softening before the fruit is stored and cooled may be regarded as an indirect cause of early breakdown.

In the light of present knowledge concerning maturity and concerning subsequent breakdown in one form or another, consideration will now be given to the effect of the hormone spray upon fruit drop and, possibly, upon maturity and ripening changes.

RESULTS OF TESTS

Pears that dropped were gathered before and after each picking in all orchards, except at Finley. The results are shown in table 1.

In the last pickup (August 28) in the Santa Clara orchard, only two trees were available for comparison. These show a relatively heavy drop because they were two of the most heavily loaded trees in the block and because the other figures are averages for considerable numbers of trees, some of which had much smaller crops.

EFFECTIVENESS OF HORMONE SPRAYS IN REDUCTION OF DROPPING

Considering all the data, one sees that the spray was always effective; up to four times as many pears dropped during the season from the unsprayed trees as from the sprayed. The widest ratio between sprayed and unsprayed plots, in respect to the number of drops, occurred at the time of the second pickup. Later, in the Sacramento River and Santa Clara Valley orchards, the ratio of drops became much narrower, evidently because of the diminishing effectiveness of the spray.

MATURITY AND SIZE OF DROPPED PEARS

Because the pears which dropped before and during early harvest presumably were of green color and, to a great extent, of small size, no attempt was made to secure information on size or condition of the drops until the late-canning picking. By this time there was a considerable amount of yellow fruit on the trees, especially in the Sacramento River plots, and some of these yellow

TABLE 1
AVERAGE NUMBER OF DROPPED PEARS UNDER SPRAYED AND UNSPRAYED TREES, 1944

| District and date | Sprayed | | Unsprayed | | Approximate ratio of sprayed to unsprayed |
|--------------------|-----------------|-----------------|-----------------|-----------------|---|
| | Number of trees | Number of drops | Number of trees | Number of drops | |
| Sacramento River | | | | | |
| July 25..... | 11 | 41 | 11 | 80 | 1 to 2 |
| August 8..... | 11 | 17 | 11 | 280 | 1 to 16 |
| August 15..... | 33 | 28 | 3 | 70 | 1 to 2 |
| August 21..... | 3 | 53 | 3 | 93 | 1 to 2 |
| Season total..... | | 139 | | 523 | |
| Santa Clara Valley | | | | | |
| August 3..... | 20 | 29 | 16 | 28 | 1 to 1 |
| August 17..... | 20 | 12 | 15 | 110 | 1 to 9 |
| August 28..... | 1 | 540 | 1 | 615 | 1 to 1 |
| Season total..... | | 581 | | 753 | |
| Kelseyville | | | | | |
| August 10..... | 3 | 275 | 3 | 550 | 1 to 2 |
| August 24..... | 3 | 45 | 3 | 163 | 1 to 3 |
| September 7..... | 3 | 137 | 3 | 229 | 1 to 3 |
| Season total..... | | 457 | | 942 | |

TABLE 2
DISTRIBUTION OF SIZES OF PEARS DROPPING IN THE SACRAMENTO RIVER PLOTS

| Treatment and date | Number of pears dropped | | |
|--------------------|-------------------------|-----------------|----------------|
| | 2½ inches or less | 2½ to 2¾ inches | Over 2¾ inches |
| Sprayed trees: | | | |
| August 15..... | 34 | 17 | 12 |
| August 21..... | 17 | 29 | 5 |
| Unsprayed trees | | | |
| August 15..... | 27 | 30 | 9 |
| August 21..... | 14 | 19 | 17 |
| Total | 92 | 95 | 43 |

pears were already showing watery breakdown. At the cleanup picking, one week later, all size groups contained green and yellow pears. Many of the yellow, overripe pears from both the sprayed and unsprayed trees in the Sacramento River orchard were on the ground; the ratio of the sprayed to unsprayed pears was approximately 1 to 2 (table 1). Of these a considerable number were so broken down that they could not be measured and classified for size. The general results (table 2) show that much of the dropped fruit, even near the end of commercial harvest, was $2\frac{1}{2}$ inches or less in diameter.

When dropped pears from under four unsprayed trees in the Santa Clara orchard were counted and sized on August 17 (midseason picking), 83 per cent proved to be smaller than $2\frac{1}{2}$ inches in diameter, whereas the remaining 17 per cent were $2\frac{1}{2}$ to $2\frac{3}{4}$ inches. The drop in the Kelseyville orchard also included a considerable percentage of small sizes.

Evidently, therefore, the drop contained all sizes of fruit. Whether the different sizes that dropped were in the same proportions as they occurred on the tree cannot be stated. Apparently, however, a greater percentage of small pears dropped than of large. Just how much the small pears, prevented by the hormone spray from dropping, increased in size was likewise not determined.

CONDITION OF FRUIT AT HARVEST

Shipping-Maturity Picking.—Although these tests were conducted primarily with fruit considered sufficiently mature for canning, an earlier picking, representing shipping maturity, was made of fruit from the Sacramento River orchard on July 17, soon after carload shipments had begun. At this time some selection was necessary to obtain fruit $2\frac{1}{2}$ inches in diameter. The pears, however, were considered to be of good shipping maturity, having a $1\frac{1}{2}$ to 2 color and a pressure test of 20 to 21 pounds.

Early-Canning Picking.—At the beginning of canning harvest in all three districts, the condition of the fruit on the trees in sprayed and unsprayed plots was not appreciably different. In picking, however, the sprayed pears in the Santa Clara orchard were found to be more firmly attached to the spurs than the unsprayed. The pears were still increasing in size, and $2\frac{1}{2}$ -inch specimens were somewhat scarce. The fruit from the Sacramento River and Lake County was light green (no. 2 on the color chart), whereas that from the Santa Clara Valley was little past green, or a no. 1 color. The pressure test in all orchards ranged within a half pound, more or less, of 19 pounds for the sprayed plots, and a fraction over 19 pounds for all the unsprayed plots, except in the Sacramento River pears, which averaged only 17.8 pounds. Even at the shipping-maturity picking on the Sacramento River, one week previous, pressure tests were 20.9 pounds in the sprayed fruit and 20.1 pounds in the unsprayed—soft enough to ensure fair to good eating quality on ripening. Soluble solids in the juice, in the early-canning fruits, ranged a fraction above 11.0 per cent, except in the Finley orchard, where they were 12.4 per cent in the sprayed pears and 13.0 per cent in the unsprayed. The Finley fruit was conspicuous throughout the season for the high solids content of the juice. With successive pickings, advancing maturity was indicated by deepening yellow ground color, lower pressure tests, and increasing percentage of soluble solids.

Midseason-Canning Picking.—This picking was made in all districts about 2 weeks after the early-canning picking. (See picking dates in tables 4 to 8.) Since the previous picking, size had increased so that pears between $2\frac{5}{8}$ inches and $2\frac{3}{4}$ inches in diameter were most representative of the fruit on the trees and were considered uniform enough for experimental purposes, and most suitable for canning.

Some difference in color between pears from different districts had developed at the time of midseason picking. Fruit from the Santa Clara Valley, which was greenest, was now an even no. 2 color; that from the Sacramento River district and from Lake County was rated 2 plus to $2\frac{1}{2}$ color. Some of the Finley pears were classified $2\frac{1}{2}$ to 3.

Slight differences in firmness were evident in midseason pears from the various districts. Sacramento River pears were about a pound softer than Santa Clara and Lake County pears were a pound or so harder than those from the other two districts.

Sprayed pears from the Sacramento River and Santa Clara Valley were slightly softer than unsprayed; those from Lake County, slightly firmer. These differences, though not in themselves significant, fall in line with the trend that was later observed.

The percentage of soluble solids in the juice was only a fraction greater than for the early-canning pears; otherwise, the data show no consistent or significant difference in the solids in sprayed and unsprayed fruit.

Late-Canning Picking.—At the late-canning picking, made a day or so before the end of commercial harvest in the various districts, it was not possible to maintain the same rigorous uniformity as in previous pickings. Only in the Sacramento River plots was it possible to secure enough $2\frac{5}{8}$ - to $2\frac{3}{4}$ -inch pears. In the Santa Clara Valley, all lots included fruit from $2\frac{1}{2}$ to 3 inches; in the Kelseyville plots, the fruit was $2\frac{3}{4}$ to 3 inches; and in the Finley orchard, sprayed fruit was $2\frac{3}{4}$ to 3, unsprayed fruit $2\frac{5}{8}$ to 3 inches. Thus the Sacramento River pears were smaller and more closely graded than those from the other districts; the Santa Clara pears had the greatest spread in sizes; the Lake County lots had the greatest average fruit size.

Most noticeable at the time of the late-canning picking, especially on the sprayed trees in the Sacramento River plots, was the occurrence of yellow pears, some of which had developed watery breakdown. Color in the different districts was mostly between no. 2 (light green) and no. 3 (yellowish green). Fruit from the Santa Clara orchard was consistently greener than that from the Sacramento River or from Lake County. Pears from Finley were uniformly of no. 3 to no. $3\frac{1}{2}$ color. In the Sacramento River and Santa Clara plots, the sprayed pears were somewhat more yellow and, by the same token, more mature than the unsprayed. No difference in color was noticeable between sprayed and unsprayed at Kelseyville, whereas at Finley the unsprayed pears were more yellow, as were pears from this orchard at the midseason picking.

Pressure tests showed that the pears from Santa Clara were the softest and those from Finley the firmest. In the Santa Clara orchard the sprayed fruit was markedly softer than the unsprayed (9.4 and 15.3 pounds respectively). The sprayed Sacramento River pears were softer than the unsprayed by

2 pounds (15.7 and 17.7 pounds respectively). Pressure tests of the Lake County pears were approximately equal, with a fractional difference indicating greater firmness in the sprayed fruit.

Soluble solids increased somewhat over previous pickings; but again, there were no differences between pears from the different districts, except that the Finley fruit was again 1 or 2 per cent higher than the fruit from the other orchards.

Cleanup Picking.—In the cleanup picking from the Sacramento River plots, a week after the late-canning harvest, the sprayed fruit was again noticeably more yellow and about 2 pounds softer than unsprayed pears of comparable size. The pressure test of sprayed fruit now averaged as low as 13.5 pounds, and many individual pears were too ripe for cannery use. A special lot of yellow pears having a pressure test of only 3 pounds were harvested and observed. All specimens showed breakdown after one day.

The criteria of color and pressure and, to a less extent, of soluble solids in the juice, showed progressive maturity in the samples at successive pickings. They also showed differences between sprayed and unsprayed fruit in the later pickings. These differences in color and firmness were modified somewhat by the growing conditions in the different districts and orchards.

Evidently in the Sacramento River and Santa Clara districts the harvest season—through circumstances largely beyond control—was too protracted. For best results, the harvest should have been completed about the time of the midseason-canning pickings.

CONDITION AND RIPENING OF PEARS AFTER 12 DAYS AT 45° F

During the simulated transit period of 12 days at 45° F, the first two pickings from the Sacramento River orchard “arrived” in good, hard, green, market condition and even when ripe were entirely free from watery breakdown. The first picking required 5 days at 65° to ripen; the second, only 3 days. Fruit of the third, fourth, and fifth pickings showed considerable “color” upon arrival and ripened in 1 to 3 days. Color differences noted at harvest between sprayed and unsprayed fruit in the later pickings still persisted. These pickings (the third, fourth, and fifth) contained 1 and 0, 4 and 2, and 10 and 1 per cent watery breakdown, sprayed and unsprayed, respectively. A special lot of sprayed pears from the last picking on August 21, with yellow color, “arrived” with 77 per cent of the fruit showing watery breakdown. No yellow pears showing watery breakdown were found on the unsprayed trees for comparison.

The influence of the hormone spray upon the time of ripening was evident in the last two pickings (late-canning and cleanup), and in the sprayed pears of the last picking, watery breakdown increased from 10 per cent when ripe to 25 per cent 2 days later. Total breakdown in the unsprayed pears was only 4 per cent.

Only slight color increases occurred in the fruit from the Santa Clara Valley; and after the 12-day shipping period, no differences were noticeable between sprayed and unsprayed pears. The first picking required 4 days to ripen; the second and third, only 2 days. A small percentage of watery breakdown developed in the second picking by the time the pears were ready for

use. Fruit of the third picking "arrived" with 7 and 1 per cent watery breakdown, sprayed and unsprayed respectively. Again, a special lot of sprayed pears showing a 3½ color when picked contained 41 per cent watery breakdown after the 12-day transit period. All lots from the two orchards in Lake County "arrived" and ripened without breakdown, and without noticeable differences in color between sprayed and unsprayed pears.

Observations made on all these lots 3 to 6 days after they reached eating or canning ripeness showed a great increase in the amount of watery breakdown in the fruit harvested after August 15. Since pears designed to be consumed fresh are usually held by the dealer for several days after becoming ripe, these results are especially significant. Within a period of 3 to 4 days, two thirds to three fourths of the sprayed pears in the later pickings from the Sacramento River district became worthless. Fruit from the Santa Clara Valley likewise deteriorated rapidly, but with less breakdown showing externally. Only in the last picking did the hormone spray have any apparent influence upon the amount or severity of watery breakdown.

No consistent influence of the spray upon breakdown was noted in the Lake County pears, but the results relative to maturity at harvest show that watery breakdown is definitely associated with late harvesting and overmaturity.

CONDITION OF PEARS OUT OF STORAGE

Early-Canning Picking.—The early-canning picking of pears from all districts showed a consistent advance toward maturity during storage, but all were sound and in good condition upon removal. A delay of 3 days before storage was reflected in increased color as compared with one day's delay, and had a marked effect on softening of the pears from Kelseyville. In the Sacramento River and Lake County samples, during the storage period, the total soluble solids in the juice showed a consistent advance of about 1 per cent over the total at harvest. There was little or no such increase in the Santa Clara Valley pears.

In comparing sprayed and unsprayed pears from the different districts it was found that: sprayed fruit from the Sacramento River was more yellow and slightly less firm; sprayed pears from the Santa Clara Valley were also more yellow, where any difference existed, and in three out of four samples were less firm by 3 or 4 pounds. Kelseyville pears showed little difference in color between sprayed and unsprayed lots; the only significant difference in pressure was in the samples delayed 3 days and stored 60 days, where the sprayed pears were 5 pounds firmer. Pears from Finley showed no difference in color, but the sprayed ones were 2 pounds softer. Since this orchard was represented by fruit secured from a single sprayed and unsprayed tree, the observations of differences are given less weight than those for the other locations where sampling was more extensive.

Considering all districts, one notes that where differences existed, the sprayed pears at this time were somewhat more yellow and less firm and, by these standards, riper, than the unsprayed, with the unaccountable exception of Santa Clara Valley and Kelseyville samples that were delayed 3 days and stored 60 days. Soluble solids in sprayed and unsprayed pears from all orchards showed little variation and no significant differences.

Midseason-Canning Picking.—Although exceeding 5 per cent in only one instance, watery breakdown in the samples as they were removed from storage *begins with this picking*. In the Lake County fruit harvested with a firmness of approximately 18.0 pounds, the breakdown was negligible, only 1 per cent appearing in one out of eight samples. In the other two districts, only one sample exceeded 5 per cent. In this exceptional case, where the Santa Clara Valley pears were delayed 3 days in getting into storage, 51 per cent of the lot was worthless when removed for ripening.

All Sacramento River samples but one had 1 to 5 per cent watery breakdown, the exception being in the unsprayed fruit stored for 40 days with 1 day's delay between harvesting and storage. None of the unsprayed lots had over 2 per cent. The two sprayed lots, delayed 3 days, had 5 per cent watery breakdown.

Stored after only 1 day's delay, Santa Clara lots had only 1 per cent watery breakdown in sprayed fruit after 60 days. Both sprayed and unsprayed pears, delayed 3 days and stored 40 days, had 5 per cent loss through watery breakdown, whereas those delayed 3 days and stored 60 days showed 51 per cent loss in the sprayed and only 6 per cent in the unsprayed.

Kelseyville pears had breakdown of only 1 per cent in one lot of fruit (this in the unsprayed sample delayed 3 days and stored 40 days). Pears from Finley, with only four lots in the picking, all delayed 3 days, had breakdown of only 2 per cent in the unsprayed sample stored 60 days.

In color and firmness, sprayed fruit from the various orchards when removed from storage was not greatly different from the unsprayed. Where differences occurred, the sprayed pears were usually more yellow and less firm.

Samples from the Sacramento River showed more color development in storage than those harvested 1 and 2 weeks earlier. Color differences between sprayed and unsprayed fruit were not always noticeable; but where they existed, a higher percentage of the sprayed pears were more yellow. Associated with the greater color development in storage of this picking of fruit was the appearance of pear scald on a number of pears after 60 days in storage. In all samples except fruit subject to a 3-day delay and a 60-day storage period, the sprayed pears were softer than the unsprayed.

In pears from Santa Clara Valley (except fruit held for 60 days with a 3-day delay, which was essentially fully ripe when removed from storage and was a full no. 4 color), sprayed lots showed a somewhat higher percentage of yellow pears than the unsprayed. Differences in firmness were neither great nor consistent.

Fruit from Kelseyville and Finley developed considerable color in storage. The samples delayed for 3 days were mostly 3½ to 4 in color; those delayed 1 day, 2½ to 3½ in color. Sprayed fruit from the Kelseyville orchard was sometimes of slightly higher color than the unsprayed. This was not true of the Finley pears; in them, after a 60-day storage period, the reverse condition existed.

According to these observations on fruit coming out of storage, the Sacramento River and Santa Clara Valley pears had at this time reached the maximum maturity for safe handling; the latter fruit, especially, after reaching maximum maturity went down very fast, because of delayed cooling and

prolonged storage. The samples containing the most breakdown included some of the softest pears. The Sacramento River samples with 5 per cent of watery breakdown tested only 7 pounds or a fraction more in firmness. Santa Clara Valley pears showing 5 or more per cent of watery breakdown had a pressure test of 3 to 4 pounds and were eating ripe. The only Kelseyville sample to show watery breakdown (one pear in the box) was also the softest (9.7 pounds) from that orchard. The same was true of the Finley pears.

Soluble solids in the juice proved to be lowest in the Santa Clara Valley pears, highest in the Finley. There was little or no difference between comparable sprayed and unsprayed pears.

Late-Canning Picking.—In the late-canning pears coming out of storage there were *greater* losses from watery breakdown than in the midseason-canning fruit. Most striking was the extent and consistency of differences between sprayed and unsprayed pears in the Sacramento River lots, where the sprayed samples had losses as great as 54 per cent and the unsprayed a maximum loss of only 9 per cent. About the same degree of loss (13 per cent and 9 per cent) occurred in the two Santa Clara Valley samples as in comparable Sacramento River samples that had received the same handling and storage treatment. The difference between sprayed and unsprayed was not, however, so marked as in the comparable Sacramento River lots, which showed 14 per cent and 3 per cent for sprayed and unsprayed respectively. Much less watery breakdown occurred in pears from Lake County. In those from Kelseyville three samples had no watery breakdown, and none had more than 4 per cent. The Finley pears also had three samples free from this trouble, and there was a maximum of 10 per cent in any lot. In the Finley orchard, fruit from the unsprayed tree had less loss from watery breakdown than the fruit from the sprayed tree—the reverse of the condition usually observed.

According to these data, wherever there was a considerable difference in losses from watery breakdown between sprayed and unsprayed fruit, both in the midseason and in late pickings, the samples having the most breakdown contained fruits with the lowest pressure test. This fact is highly important. The statement applies particularly well to the Sacramento River pears, where the sprayed lots conspicuously showed the greater loss.

CONDITION AT CANNING TIME AND SUBSEQUENT BREAKDOWN

Early-Canning Picking.—All lots from all districts, whether sprayed fruit or unsprayed, reached canning ripeness without developing watery breakdown. Average firmness at the time of harvest was 19.0 pounds. Santa Clara Valley fruit was mostly green (no. 1½ color), whereas Sacramento River and Lake County pears were light green (no. 2).

Sacramento River pears that were delayed 1 day before a 40-day storage, and were reduced to 32° F only after 6 days, required 5 days to ripen; those that were delayed 3 days in storing, only 4 days. After 60 days' storage the unsprayed fruit likewise required 5 and 4 days to ripen (according to the delay); each of the sprayed samples ripened 1 day earlier. Both sprayed and unsprayed fruit ripened in a relatively uniform manner. Sprayed pears held for 60 days before ripening were of higher color when ripe than the unsprayed. As stated above, fruit harvested at early-canning maturity ripened with no

watery breakdown but, 4 to 5 days after becoming ripe, failed from calyx and internal breakdown.

Santa Clara Valley pears stored 40 days ripened in 4 days. This period was the same for sprayed and unsprayed fruit delayed 1 day and also for fruit delayed 3 days. Fruit stored 60 days ripened in 2 or 3 days. The color, firmness, and general ripening of the Santa Clara pears were less uniform than desired. Considerable irregularity existed in both sprayed and unsprayed fruit. The sprayed, however, when removed from storage had a higher percentage of yellow pears. Ripening and subsequent breakdown were relatively rapid, and commercial life after storage was short. In 3 to 4 days after reaching the stage of maturity for canning, the fruit was discarded because of a high percentage of core and general internal breakdown. At this time, but not when first ripe, 3 out of 4 samples of pears stored for 60 days developed 2 per cent of watery breakdown.

Ripening and breakdown of early-canning pears appeared generally similar in Lake County and Sacramento River fruit, the 3-day delay in storing having no apparent effect upon the sprayed pears. Most samples ripened with good yellow color in 4 days. All lots ripened uniformly except the sprayed fruit from Kelseyville that was held in storage 60 days. For some reason, ripening of this fruit was slightly slower and more irregular. A little incipient scald also developed by the time the Kelseyville pears were ripe. Five days after becoming ripe, or 9 to 10 days out of storage, all Kelseyville samples were discarded because of calyx and internal (rather than watery) breakdown.

Midseason-Canning Picking.—Pears harvested at midseason ripened 1 to 2 days sooner, or in three fourths to one half the time required for comparable lots harvested earlier. In fact, fruit from sprayed trees in the Santa Clara Valley, delayed 3 days before storing, was canning ripe upon removal from storage after 40 days. After 60 days' storage half of the fruit was worthless. Because the pears ripened more rapidly at this midseason picking, there was little difference between the ripening periods of sprayed and unsprayed samples. At this time, however, *delayed storage*, which becomes a highly important factor, reduced the ripening time of one lot of Sacramento River pears from 3 and 4 days to 1 day, and the ripening time of Santa Clara Valley fruit from 3 days to 0 days.

When the fruit was ready for canning, little additional watery breakdown occurred in the pears from any district over that which developed while they were in storage. Two or three days after becoming ripe, however, or 2 to 7 days out of storage, the percentage of breakdown in the Santa Clara Valley fruit had increased very markedly. Naturally, the pears were then past marketable condition; but the results emphasize the necessity of handling them from this district quickly after they become ripe. In three out of four comparisons of this picking, sprayed pears developed more breakdown than unsprayed.

Late-Canning Picking.—All pears harvested at the end of the picking season, even those from the Santa Clara Valley, came out of storage with a considerable percentage showing yellow color, and ripened in 1 to 4 days. (A midseason picking of Santa Clara pears, delayed 3 days before going into storage, was ripe upon removal. Unfortunately, a lack of sufficient fruit pre-

vented the securing of delayed samples at the late-canning stage.) Sprayed pears from the Sacramento River, 2 pounds softer when picked, usually ripened 1 day ahead of the unsprayed.

Again, there was little increase in the amount of watery breakdown occurring during the first few days after the fruit was removed from storage. Upon removal from storage, however, the percentage of breakdown in the sprayed pears from the Sacramento River, and in the delayed-storage lot from Santa Clara Valley, was 25 to 50 per cent. Within 2 to 5 days after the fruit became ripe, both the visible watery breakdown and the internal breakdown had rendered most of it unfit for use. Watery breakdown continued to be worse in the sprayed pears from the Sacramento River and the Santa Clara Valley. It was of least consequence in Lake County fruit, where the hormone produced rather inconsistent or no results.

DELAY IN HANDLING AND STORAGE

As outlined under the cooling and storage program, all storage samples of fruit, in order to conform to commercial handling, were kept at room temperature for 24 hours after harvest and then, after being placed in storage, were cooled gradually for about 6 days. Comparable boxes were delayed at outside temperatures for 72 hours.

With few exceptions this longer-delayed fruit had higher color, less firmness, and more watery breakdown, out of storage and later, than pears that did not undergo this extra 48-hour delay. Often the greater color and softness were reflected in more rapid ripening.

As previous experimental tests have shown, delay in cooling the fruit to below 50° F results in rapid ripening and deterioration. In general, Bartlett pears at 53° ripen about twice as rapidly as they do at 43°, and at the latter temperature about four times as rapidly as at 31°.° Since watery breakdown results from overmaturity, cooling to approximately 32° with the least possible delay is highly important in reducing loss. The relation between delayed and prolonged storage is also reflected in the quality of the canned product. (See table 3.)

COMPARISON OF LARGE- AND MEDIUM-SIZED PEARS

With midseason and late-canning pickings, several lots of larger-sized fruit (above 2¾ inches) were picked for comparison with those 2½ to 2¾ inches in diameter. At harvest time, color differences were evident only in the comparison of fruit from the Finley orchard in Lake County; the larger pears from the sprayed trees at Finley were 2 pounds softer when harvested, but slightly firmer out of storage. In the Sacramento River and Santa Clara Valley lots, the large fruits were about ½ pound firmer than those of medium size when picked, and only slightly (at most 1 pound) firmer out of storage. The large Sacramento River pears did, however, appear to ripen a little faster than the small ones; but when they were ripe the average percentage of breakdown was no greater. (Table 8.)

These observations, although limited in scope, agree with numerous pres-

° Magness, J. R., H. C. Diehl, and F. W. Allen. Investigations on the handling of Bartlett pears from the Pacific Coast districts. U. S. Dept. Agr. Tech. Bul. 140:1-28. 1929.

TABLE 3
QUALITY OF EXPERIMENTAL LOTS OF FRESH BARTLETT PEARS*

| Picking date and code mark | Very good | Good | Fair (brittle) | Poor (brittle and mealy, some breakdown) | Very poor (mealy or mushy— 10% to 50% breakdown) |
|------------------------------------|-----------|------|-------------------|---|--|
| Sacramento River district, 32 lots | | | | | |
| July 17: | | | | | |
| RX H SP..... | × | .. | .. | .. | .. |
| RX S40 UN†..... | × | .. | .. | .. | .. |
| RX S40 SP†..... | × | .. | .. | .. | .. |
| July 25: | | | | | |
| R1 H UN..... | × | .. | .. | .. | .. |
| R1 H SP..... | × | .. | .. | .. | .. |
| R1 D1 S40 UN†..... | × | .. | .. | .. | .. |
| R1 D1 S40 SP..... | × | .. | .. | .. | .. |
| R1 D3 S40 UN†..... | × | .. | .. | .. | .. |
| R1 D3 S40 SP†..... | × | .. | .. | .. | .. |
| R1 D3 S60 UN†..... | .. | × | .. | .. | .. |
| R1 D3 S60 SP†..... | .. | × | .. | .. | .. |
| R1 D1 S60 UN..... | × | .. | .. | .. | .. |
| R1 D1 S60 SP..... | × | .. | .. | .. | .. |
| August 8: | | | | | |
| R2 H SP†..... | .. | × | .. | .. | .. |
| R2 D1 S40 UN†..... | × | .. | .. | .. | .. |
| R2 D1 S40 SP†..... | .. | × | .. | .. | .. |
| R2 D3 S40 UN†..... | .. | × | .. | .. | .. |
| R2 D3 S40 SP†..... | .. | .. | × | .. | .. |
| R2 D1 S60 UN..... | .. | × | .. | .. | .. |
| R2 D1 S60 SP†..... | .. | .. | × | .. | .. |
| R2 D3 S60 UN..... | .. | .. | × | .. | .. |
| R2 D3 S60 SP..... | .. | .. | .. | × | .. |
| August 15: | | | | | |
| R3 H UN†..... | .. | × | .. | .. | .. |
| R3 H SP†..... | .. | .. | .. | × | .. |
| R3 D1 S40 UN†..... | .. | .. | × | .. | .. |
| R3 D1 S40 SP†..... | .. | .. | .. | × | .. |
| R3 D3 S40 UN†..... | .. | .. | × | .. | .. |
| R3 D3 S40 SP†..... | .. | .. | .. | × | .. |
| August 21: | | | | | |
| R4 H UN†..... | .. | .. | × | .. | .. |
| R4 H SP†..... | .. | .. | .. | .. | × |
| R4 D1 S40 UN†..... | .. | .. | .. | × | .. |
| R4 D1 S40 SP†..... | .. | .. | .. | .. | .. |
| Santa Clara County, 20 lots | | | | | |
| August 2: | | | | | |
| S1 H UN..... | × | .. | .. | .. | .. |
| S1 H SP..... | × | .. | .. | .. | .. |
| S1 D1 S40 UN†..... | × | .. | .. | .. | .. |
| S1 D1 S40 SP†..... | × | .. | .. | .. | .. |
| S1 D3 S40 UN†..... | .. | × | .. | .. | .. |
| S1 D3 S40 SP†..... | .. | × | .. | .. | .. |
| S1 D1 S60 UN..... | × | .. | .. | .. | .. |
| S1 D1 S60 SP..... | × | .. | .. | .. | .. |
| S1 D3 S60 UN..... | .. | × | .. | .. | .. |
| S1 D3 S60 SP..... | .. | × | .. | .. | .. |

TABLE 3—(Continued)

| Picking date and code mark | Very good | Good | Fair (brittle) | Poor (brittle and mealy, some breakdown) | Very poor (mealy or mushy— 10% to 50% breakdown) |
|---|-----------|------|-------------------|---|--|
| Santa Clara County, 20 lots—(Continued) | | | | | |
| August 17: | | | | | |
| S2 H UN†..... | .. | × | .. | .. | .. |
| S2 H SP†..... | .. | .. | × | .. | .. |
| S2 D1 S40 UN†..... | .. | × | .. | .. | .. |
| S2 D1 S40 SP†..... | .. | .. | × | .. | .. |
| S2 D3 S40 UN†..... | .. | .. | × | .. | .. |
| S2 D3 S40 SP†..... | .. | .. | .. | .. | × |
| August 28: | | | | | |
| S3 H UN†..... | .. | .. | .. | × | .. |
| S3 H SP†..... | .. | .. | .. | .. | × |
| S3 D1 S40 UN..... | .. | .. | .. | .. | × |
| S3 D1 S40 SP..... | .. | .. | .. | .. | × |
| Lake County, 29 lots | | | | | |
| August 10: | | | | | |
| L1 H UN..... | × | .. | .. | .. | .. |
| L1 H SP..... | × | .. | .. | .. | .. |
| L1 D1 S40 UN†..... | × | .. | .. | .. | .. |
| L1 D1 S40 SP†..... | × | .. | .. | .. | .. |
| L1 D3 S40 UN†..... | × | .. | .. | .. | .. |
| L1 D3 S40 SP†..... | × | .. | .. | .. | .. |
| L1 D1 S60 SP..... | × | .. | .. | .. | .. |
| No UN lot | | | | | |
| L1 D3 S60 UN..... | × | .. | .. | .. | .. |
| L1 D3 S60 SP..... | × | .. | .. | .. | .. |
| August 24: | | | | | |
| L2 H UN†..... | × | .. | .. | .. | .. |
| L2 H SP†..... | .. | × | .. | .. | .. |
| L2 D1 S40 UN..... | × | .. | .. | .. | .. |
| L2 D1 S40 SP..... | × | .. | .. | .. | .. |
| L2 D3 S40 UN..... | × | .. | .. | .. | .. |
| L2 D3 S40 SP..... | .. | × | .. | .. | .. |
| L2 D1 S60 UN..... | × | .. | .. | .. | .. |
| L2 D1 S60 SP..... | .. | × | .. | .. | .. |
| L2 D3 S60 UN..... | × | .. | .. | .. | .. |
| L2 D3 S60 SP..... | .. | × | .. | .. | .. |
| September 7: | | | | | |
| L3 H UN†..... | .. | × | .. | .. | .. |
| L3 H SP†..... | .. | × | .. | .. | .. |
| L3 D1 S40 UN..... | .. | × | .. | .. | .. |
| L3 D1 S40 SP..... | .. | .. | × | .. | .. |
| L3 D3 S40 UN..... | .. | .. | × | .. | .. |
| L3 D3 S40 SP..... | .. | .. | .. | × | .. |
| L3 D1 S60 UN..... | .. | .. | × | .. | .. |
| L3 D1 S60 SP..... | .. | .. | .. | × | .. |
| L3 D3 S60 UN..... | .. | .. | .. | × | .. |
| L3 D3 S60 SP..... | .. | .. | .. | × | .. |

* Key to code used in labeling samples:

R—Sacramento River

S—Santa Clara Valley

L—Lake County

X—Shipping maturity

1—Early-canning harvest

2—Medium late-canning harvest

3—Late-canning harvest

4—Clean-up

D1—Delayed storage 1 day

D3—Delayed storage 3 days

H—"Hot" pears (no storage)

S40—Cold storage 40 days

S60—Cold storage 60 days

UN—Unsprayed

SP —Sprayed

† These lots were canned.

sure tests on different-sized fruit, which have shown that after pears become of marketable size, little direct correlation exists between size and firmness. The fact that small pears, as well as large, drop from unsprayed trees also indicates that size during the period of harvest cannot be definitely correlated with maturity.

RIPENING AND CANNING OF SPRAYED AND UNSPRAYED PEARS

The writers had few opportunities to observe the actual samples of pears ripened at San Jose. As mentioned earlier, however, all samples shipped from storage were duplicate lots of those that were studied at Davis. A. M. Erickson's observations on ripening agree in general with those of the authors. The following is his report :

In the early-picked lots of sprayed and unsprayed pears, ripening was fairly even. In the later-picked fruit there was a definite difference in sprayed and unsprayed samples. Medium-late pickings of sprayed pears ripened 12 to 24 hours, and late pickings 24 to 36 hours, ahead of unsprayed lots. There was also noted a considerable unevenness in ripening of the late-picked lots of sprayed fruit. Part of the fruit remained firm, with some properly ripe and others overripe and mushy.

Uneven ripening is an important factor in handling pears on a production basis. It is physically impossible to keep every lot segregated in storage for ripening. The mixing of sprayed and unsprayed deliveries of medium-late and late picking will produce a very uneven ripening and result in the preparation department's receiving a mixture of hard, ripe, and soft fruit.

Table 3 shows the different lots (with packer's code marks) of sprayed and unsprayed pears observed from each of the districts, the different picking dates, and the judged quality of the fruit as ripened in San Jose.

The report continues :

A study of the quality classification report indicates that pears treated with spray deteriorate rapidly as a result of delayed harvest and delayed or prolonged storage. However, it should be noted that this result was also true to a smaller, but nevertheless substantial, degree with lots that were not sprayed.

In order to determine whether sprayed pears would respond differently from unsprayed pears in processing, samples were packed from half of the above lots, and the first cutting of these samples was made January 12, 1945.

The writers were present at this time and subscribe to the general conclusions.

In every case, pears that were sprayed could not be distinguished from those that were not sprayed. Quality, flavor, and appearance were the same. Additional samples are being held for a later cutting to determine whether a longer storage period will show a difference.

DISCUSSION

The use of hormone spray by the pear growers of California has become standard practice. The experimental results obtained show its effectiveness in reducing the drop to at least 50 per cent and, at certain periods, to a very small fraction of that of unsprayed trees. Numbers of drops increase as the pears mature, subject, however, to variation with prevalence or absence of high winds. The hormone spray appeared to be effective throughout the picking period in reducing drop, but its influence seemed to diminish in the Sacramento River and Santa Clara Valley districts after the midseason picking,

the ratio of drops (sprayed and unsprayed) narrowing from 1 to 16 and 1 to 9 down to 1 to 2 or slightly less.

Fruits may drop from any of several causes; but after they attain good marketable size and the picking season has started, apparently many of them fall because of their maturity. Because the spray tends to hold the fruit on the spur, pears that otherwise would drop and become "straw" pears (allowed to drop on straw) remain attached and continue to ripen. For this reason certain pears on sprayed trees (much more than on unsprayed trees) become more advanced in maturity than most others. After midseason this condition may be observed by the presence of some yellow pears, and even broken-down pears, still attached to the same spur which bears several other fruits that are still green. This condition was observed after midseason in the Sacramento River orchard and, to a less degree, at San Jose and at Finley. Naturally, these yellow pears are sorted out before the fruit is packed or sent to a cannery. Obviously, however, there are some pears which, although appearing relatively green, are really more advanced in maturity than the rest. Not being readily discernible, they are harvested with the others. This is believed to be the basic reason why they become soft and watery while most of the fruit still remains sound.

Both at Courtland and at San Jose, sprayed fruit softened more rapidly than unsprayed and was therefore more advanced in maturity when harvested. Although the data do not warrant definite conclusions, this greater average maturity of the sprayed pears, as shown by color and firmness, was probably not entirely due to the retention by hormones of the more mature fruits; there may have been a general advance of maturity of the sprayed crop. This impression is supported by the results obtained in Gerhardt and Allmendinger's physiological investigations of hormone sprays as affecting the maturity of pears in Washington.⁷

Watery breakdown, found even in some unsprayed pears, is definitely associated with maturity and with later pickings. Only at midseason or after, when the pressure test was 16 pounds or less, was there any loss until a number of days after the fruit was ready for canning or eating.

The fact that the greatest percentage of breakdown occurred in the Sacramento River and Santa Clara Valley pears, and the least in the Lake County samples, may have two possible explanations. The picking season at Courtland was longer by one week, and the hormone spray was applied there relatively earlier. In the investigations described above, no tests were outlined to determine the effects of applying the hormone on different dates. Judging from the results, however, the dates may have influenced the relative amounts of breakdown. Observations indicate the spray becomes effective within a week after application. If it actually hastens ripening, as observations appear to indicate, one might logically conclude that the earlier it is applied, the more ripening will occur. Possibly, therefore, with an early application, losses from overmaturity might actually outweigh the advantage of protection from high winds. It is, of course, economical to combine the hormone with the last cover spray. Where, in order to secure size, or to meet a problem of labor shortage,

⁷ Gerhardt, F. G., and D. F. Allmendinger. The influence of *α*-naphthaleneacetic acid spray on maturity and storage physiology of apples, pears, and sweet cherries. Jour. Agr. Res. (In press).

prorates, or the like, the harvest season must be prolonged over 3 to 4 weeks, application of the hormone might best be delayed until after the first picking. With numerous economic factors to consider, it is difficult to recommend the best time for the spraying.

Because of the labor shortage and a desire to extend the normal harvest season, many growers have doubtless felt that a hormone spray would at least help to solve their picking problem. Unfortunately, however, while such sprays reduce dropping of fruit, they may even ripen it more quickly; and upon reaching maturity the pears should, from the standpoint of shipping and of keeping quality, be harvested without appreciable delay. Instead of lengthening the period of harvest, one may actually have to shorten it. During the past season the sprayed fruit was often so mature that picking should have been started somewhat earlier.

After being harvested, fruit continues to ripen even faster than on the tree. Unless, therefore, it is to go to nearby markets or is to be canned as "hot" fruit, ripening must be checked quickly, by means of refrigeration—a consideration just as important as the time of harvesting. Table 4 illustrates the greater breakdown in late-picked pears; in addition, tables 5, 6, and 7 illustrate the much higher percentages of breakdown where the fruit was delayed 3 days before being stored. Under present conditions, delays between harvest and storage are often unavoidable; but every effort should be made to hold them to a minimum and, wherever possible, to refrigerate the fruit within 24 hours.

Besides harvesting the fruit at proper maturity and storing with minimum delay, the storage room should have sufficient refrigeration and air circulation for rapid cooling. Under good cooling conditions the temperature of canning pears (stored unwrapped) may be brought down to 35° F or lower within 48 hours: for packed pears 60-72 hours are usually required. If large quantities of "hot" fruit are coming in daily and the storage rooms are overloaded, it is practically impossible to cool even the canning pears thoroughly for a number of days. Ripening is continuing during this period; and under the conditions of slow cooling, breakdown is likely to occur.

The period of holding in storage should also be considered; but pears picked at the proper time and handled in the proper manner should keep satisfactorily for 60 days. Breakdown within this period is usually due to overmaturity of the fruit when picked or to its becoming overmature in storage because of delayed cooling and high storage temperatures. High temperatures are also likely to cause pear scald on the fruit held for 60 days. Although incipient scald may be of little concern to cannery men, it rapidly increases after the fruit leaves storage and may result in complete loss. The extensive use of hormone sprays during the past few seasons has no doubt contributed to uneven ripening and increased the loss of both canning and shipping fruit. *Basically, however, the reason for loss is overmaturity resulting from delays in every process of picking, handling, transporting, and refrigerating.* Shortage of experienced labor, of trucks, cars, and storage space, are all factors over which there is at present little control. Had it been possible to complete harvesting in the Sacramento River orchard by August 8-10, and in the Santa Clara orchard by August 20, and had the fruit been adequately refrigerated without delay, watery breakdown would probably have been of no consequence.

SUMMARY

Watery breakdown of Bartlett pears occurred in fruit from both sprayed and unsprayed trees. It results from overmaturity, coupled with delayed and prolonged storage.

Hormone sprays are effective in reducing premature dropping of Bartlett pears, and their use for this purpose seems fully justified. Dropping of sound pears from unsprayed trees, however, indicates that the fruit is mature; hormone sprays should therefore not be used to extend the normal picking season.

Breakdown in the fruit from the Sacramento River and Santa Clara Valley orchards was more severe in the pears from sprayed trees than in those from unsprayed. Fruit from the former was more mature, partly because of the harvesting of certain pears which had dropped from the unsprayed trees, but also, apparently, because the relatively early sprayings hastened the ripening of the later pickings.

Little breakdown would have occurred had harvest been completed in some orchards 10 days to 2 weeks earlier and the fruits placed under adequate refrigeration with less delay.

More rapid ripening and greater loss from breakdown in sprayed pears was noted in numerous lots ripened at the cannery; but no differences in processing the sprayed and unsprayed fruit were evident when samples were cut January 12, 1945.

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HORMONE SPRAYS IN RELATION TO RIPENING AND BREAKDOWN OF BARTLETT PEARS UNDER SIMULATED SHIPPING CONDITIONS, 1944

TABLE 4

| Harvesting record | | | | | | | | | |
|-------------------|------------------------------|--------------|-----------|-----------|-----------|----------------|-----------|---|--|
| Code mark | Locality and date of picking | Color range* | | Pressure† | | Soluble solids | | Remarks | |
| | | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | | |
| | | color no. | color no. | pounds | pounds | per cent | per cent | | |
| RX R1 R2 | Sacramento River: | | | | | | | Pears of good shipping maturity, 2 3⁄8 inches in diameter Unsprayed pears softer but of slightly more color than sprayed Maximum shipping maturity. Sprayed, now of more color than unsprayed | |
| | July 17..... | 1½ to 2 | 2 | 20.9 | 20.1 | 11.0 | 11.0 | | |
| | July 25..... | 2 | 2 | 19.5 | 17.8 | 11.5 | 11.4 | | |
| | August 8..... | 2 to 2½ | 2 | 15.6 | 16.5 | 12.2 | 12.2 | | |
| R3 R4 | August 15..... | 2½ to 4 | 2 to 3 | 15.7 | 17.7 | 12.9 | 12.4 | Sprayed, more color than unsprayed Unsprayed pears more uniform in color than sprayed | |
| | August 21..... | 2½ to 4 | 2½ to 3 | 13.5 | 15.4 | 13.0 | 12.8 | | |
| S1 S2 S3 | Santa Clara: | | | | | | | Sprayed pears softer than unsprayed Sprayed pears softer than unsprayed Sprayed pears more yellow and much softer than unsprayed | |
| | August 3..... | 1½ | 1½ | 18.6 | 19.5 | 11.3 | 10.8 | | |
| | August 17..... | 1½ to 2 | 1½ to 2 | 16.7 | 17.4 | 11.0 | 11.7 | | |
| | August 28..... | 2 to 3 | 2 to 2½ | 9.4 | 15.3 | 12.7 | 13.0 | | |
| L1 L2 L3 | Kelseyville: | | | | | | | Sprayed and unsprayed pears similar Sprayed and unsprayed pears similar Sprayed and unsprayed pears similar | |
| | August 10..... | 2 | 2 | 19.2 | 19.5 | 11.2 | 11.0 | | |
| | August 24..... | 2 to 2½ | 2 to 2½ | 18.7 | 17.9 | 11.2 | 12.2 | | |
| A1 A2 A3 | September 7..... | 2½ to 3 | 2½ to 3 | 16.3 | 16.0 | 12.2 | 12.8 | Sprayed and unsprayed pears similar Sprayed pears of less color, but firmer than unsprayed. (Pears from single trees only.) Sprayed pears of less color, but firmer than unsprayed. (Pears from single trees only.) | |
| | Finley: | | | | | | | | |
| | August 11..... | 2 | 2 | 19.6 | 19.3 | 12.4 | 13.0 | | |
| | August 28..... | 2½ | 2½ to 3 | 18.7 | 17.9 | 12.6 | 13.6 | | |
| A3 | September 8..... | 3 | 3 to 3½ | 17.8 | 17.1 | 13.4 | 14.0 | | |

Storage record after 12 days at 45° F

| Code mark | Locality and date of picking | Color range* | | Visible watery breakdown† | | Remarks |
|-----------|------------------------------|--------------|-----------|---------------------------|-----------|--|
| | | Sprayed | Unsprayed | Sprayed | Unsprayed | |
| | | color no. | color no. | per cent | per cent | |
| RX | Sacramento River: | | | | | All pears green and hard |
| R1 | July 17..... | ..... | ..... | 0 | 0 | All pears green and hard |
| R2 | July 25..... | 2 | 2 | 0 | 0 | Sprayed and unsprayed similar: color mostly 2½ to 3 |
| R3 | August 8..... | 2½ to 4+ | 2½ to 4+ | 1 | 0 | Mostly of 3 to 3½ color but higher percentage of yellow pears in sprayed |
| R4 | August 15..... | 3 to 4+ | 3 to 4+ | 4 | 2 | Mostly of 3½ color but higher percentage of yellow pears in sprayed |
| | August 21..... | 3 to 4 | 3 to 4 | 10 | 1 | |
| S1 | Santa Clara: | | | | | All pears in good condition; sprayed of slightly more color |
| S2 | August 3..... | 2 to 2½ | 2 to 2½ | 0 | 0 | All pears in good condition; sprayed of slightly more color |
| S3 | August 17..... | 2½ to 3 | 2½ | 0 | 0 | Sound pears rather dry and woody |
| | August 28..... | 2½ to 4+ | 2½ to 4+ | 7 | 1 | |
| L1 | Kelseyville: | | | | | Little color change over that when picked |
| L2 | August 10..... | 2 | 2 | 0 | 0 | All pears in good condition; very uniform ripening |
| L3 | August 24..... | 2½ to 3½ | 2½ to 3½ | 0 | 0 | All pears in good condition; very uniform ripening |
| | September 7..... | 3 to 3½ | 3 to 3½ | 0 | 0 | |
| A1 | Finley: | | | | | Little color change over that when picked |
| A2 | August 11..... | 2 | 2 | 0 | 0 | All pears in good condition |
| A3 | August 28..... | 2½ to 3½ | 2½ to 3½ | 0 | 0 | All pears in good condition |
| | September 8..... | 3½ to 4 | 3½ to 4 | 0 | 0 | |

* Color range estimated by use of official color chart for standards of pear maturity: 1, green; 2, light green; 3, yellowish green; 4, yellow (greenish yellow); 4+, full yellow.

† Firmness in pounds determined by the U. S. Department of Agriculture pressure tester with a 5/16-inch plunger point.

‡ Per cent visible watery breakdown is cumulative; includes breakdown occurring during shipping period; does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 4—(Continued)

| Ripening record | | | | | | |
|-----------------|------------------------------|-------------------|-----------|---------------------------|-----------|--|
| Code mark | Locality and date of picking | Period until ripe | | Visible watery breakdown† | | Remarks |
| | | Sprayed | Unsprayed | Sprayed | Unsprayed | |
| | | days | days | per cent | per cent | |
| RX | Sacramento River: |  |  |  |  | ..... |
| R1 | July 17..... | 5 | 5 | 0 | 0 | Sprayed pears more yellow than unsprayed |
| R2 | July 25..... | 3 | 3 | 0 | 0 | Sprayed pears more yellow than unsprayed |
| R3 | August 8..... | 2 | 2 | 1 | 1 | Sprayed pears definitely more mature |
| R4 | August 15..... | 0 to 1 | 1 | 4 | 2 | Sprayed pears definitely more mature |
| | August 21..... | 2 | 2 to 3 | 25 | 4 | |
| S1 | Santa Clara: | | | | | Sprayed and unsprayed pears similar |
| S2 | August 3..... | 4 | 4 | 0 | 0 | Sprayed and unsprayed pears of 3½ to 4 color: too ripe for eastern markets |
| S3 | August 17..... | 2 | 2 | 0 | 1 | Sprayed and unsprayed of 3½ to 4 color: too ripe for eastern markets |
| | August 28..... | 2 | 2 | 7 | 3 | |
| L1 | Kelseyville: | | | | | Sprayed and unsprayed pears of 3½ to 4 color |
| L2 | August 10..... | 3 | 3 | 0 | 0 | Sprayed and unsprayed pears of 4 color: all in good condition |
| L3 | August 24..... | 3 | 3 | 0 | 0 | Sprayed and unsprayed pears of 4 color, and all in good condition |
| | September 7..... | 3 | 3 | 0 | 0 | |
| A1 | Finley: | | | | | All pears of 4 color: all in good condition |
| A2 | August 11..... | 4 | 4 | 0 | 0 | All pears of 4 color: all in good condition |
| A3 | August 28..... | 3 | 3 | 0 | 0 | All pears of 4 color: all in good condition |
| | September 8..... | 3 | 3 | 0 | 0 | |

| After-ripening record | | | | | | | | | | |
|-----------------------|------------------------------|-------------------|------------|---------------------------|------------|--------------------|------------|----------------------------|------------|---|
| Code mark | Locality and date of picking | Period after ripe | | Visible watery breakdown† | | Internal breakdown | | Total percentage breakdown | | Remarks |
| | | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | |
| | | | | | | | | | | |
| RX | Sacramento River: | | | | | | | | | |
| R1 | July 17..... | 4 | 4 | 0 | 0 | 84 | 68 | 84 | 68 | ..... |
| R2 | July 25..... | 4 | 4 | 0 | 9 | 80 | 72 | 80 | 72 | ..... |
| R3 | August 8..... | 5 | 5 | 1 | 1 | 83 | 72 | 83 | 72 | Much incipient calyx breakdown |
| | August 15..... | 4 | 4 | 64 | 32 | 80 | 0 | 64 | 32 | Breakdown more advanced in sprayed pears: complete after 10 days |
| R4 | August 21..... | 3 | 3 | 74 | 8 | 15 | 16 | 89 | 24 | Breakdown much worse in sprayed pears |
| S1 | Santa Clara: | | | | | | | | | |
| S2 | August 3..... | 2 | 2 | 0 | 0 | 100 | 100 | 100 | 100 | ..... |
| | August 17..... | 4 | 4 | 37 | 37 | 60 | 63 | 97 | 100 | Several sprayed and unsprayed pears with severe visible breakdown |
| S3 | August 28..... | 2 | 2 | 53 | 12 | 30 | 38 | 83 | 50 | ..... |
| L1 | Kelseyville: | | | | | | | | | |
| L2 | August 10..... | 4 | 4 | 0 | 0 | 75 | 63 | 75 | 63 | Breakdown soft, internal, not mushy |
| L3 | August 24..... | 6 | 6 | 13 | 51 | 87 | 49 | 100 | 100 | Watery breakdown, all incipient around calyx |
| | September 7..... | 4 | 4 | 14 | 34 | 22 | 38 | 36 | 72 | Watery breakdown, all incipient around calyx |
| A1 | Finley: | | | | | | | | | |
| | August 11..... | 4 | 4 | 12 | 12 | 78 | 70 | 90 | 82 | All pears soft and watery 10 days after ripening; breakdown further advanced in sprayed |
| A2 | August 28..... | 6 | 6 | 22 | 19 | 78 | 64 | 100 | 83 | ..... |
| A3 | September 8..... | 5 | 5 | 24 | 4 | 65 | 65 | 89 | 69 | ..... |

† Per cent visible watery breakdown is cumulative; includes breakdown occurring during shipping period; does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 5
HORMONE SPRAYS IN RELATION TO RIPENING AND BREAKDOWN OF BARTLETT PEARS; SACRAMENTO RIVER, 1944

| Harvesting record | | | | | | | | | | | | |
|-------------------|---------------------------------------|---------------------|------------------|------------------|------------------|----------------|-----------|---|-----------|--|--|--|
| Code mark | Date of picking and stage of maturity | Color range* | | Pressure† | | Soluble solids | | Remarks | | | | |
| | | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | | | | | |
| | | color no. | color no. | pounds | pounds | per cent | per cent | | | | | |
| RX | July 17, shipping..... | 1½ to 2 | 2 | 20.9 | 20.1 | 11.0 | 11.0 | Only a few pears as large as 2½ inches Sizes 2½ to 2 5/8 inches Sprayed, mostly 3 color; unsprayed, mostly 2½ color. Ripening on tree, especially sprayed plot Sprayed, mostly 3 color; unsprayed more uniform | | | | |
| R1 | July 25, early canning..... | 2 | 2 | 19.5 | 17.9 | 11.5 | 11.4 | | | | | |
| R2 | August 8, midseason canning.... | 2+ to 2½ | 2+ | 15.6 | 16.5 | 12.2 | 12.0 | | | | | |
| R3 | August 15, late canning..... | 2½ to 4 | 2 to 3 | 15.7 | 17.7 | 12.9 | 12.4 | | | | | |
| R4 | August 21, last of crop..... | 2½ to 4 | 2½ to 3 | 13.5 | 15.4 | 13.0 | 12.8 | | | | | |
| Storage records | | | | | | | | | | | | |
| Code mark | Date of picking and stage of maturity | Delay after picking | Storage at 32° F | Color range* | | Pressure† | | Soluble solids | | Remarks | | |
| | | | | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | | | |
| | | | | color no. | color no. | pounds | pounds | per cent | per cent | | | |
| RX | July 17, shipping.... | 1 | 40 | 1½ to 2 | 2 | .... | .... | .... | 0 | Fruit green: good condition | | |
| R1 | July 25, early canning..... | 1 | 40 | 2 to 2+ | 2 | 18.4 | 18.8 | 12.3 | 0 | Color differences slight | | |
| | | | 60 | 2 to 3 (50%: 2½) | 2 to 3 (40%: 2½) | 17.5 | 17.8 | 12.4 | 0 | Sprayed, slightly more yellow | | |
| | | 3 | 40 | 2½ to 3 | 2 to 2½ | .... | .... | .... | 0 | Sprayed, more yellow | | |
| | | | 60 | 2 to 3 (50%: 3) | 2 to 3 (3%: 3) | 16.7 | 18.7 | 12.3 | 0 | Sprayed, much higher percentage of no. 3 color | | |

| | | | | | | | | | | | | |
|----|-------------------------------------|----------------------|----|---------------------------------------|--|------|------|------|------|----|----|--|
| R2 | August 8, midseason canning..... | { 1 1 3 3 } | 40 | 3 to 3½ | 3 to 3½ | 14.2 | 15.1 | 13.0 | 12.8 | 1 | 0 | Sprayed, softer than un- sprayed |
| | | | 60 | 3½ to 4 (mostly 3½) | 3 to 4 (mostly 3½) | 11.0 | 16.5 | 12.4 | 12.4 | 2 | 2 | Scald on sprayed and un- sprayed |
| | | | 40 | 3 to 4 (80%:3½; 7%:3) | 3 to 4 (52%:3½; 46%:3) | 7.0 | 10.7 | 12.6 | 13.9 | 5 | 2 | Breakdown severe |
| | | | 60 | 3 to 4 (46%:4) | 3 to 4 (55%:4) | 7.6 | 7.2 | 12.7 | 12.8 | 5 | 2 | Scald on sprayed and un- sprayed |
| R3 | August 15, late can- ning..... | { 1 1 3 3 } | 40 | 3½ to 4 (56%:4; 26%: 3½) | 3 to 4 (30%:4; 60%:3½) | 7.6 | 12.6 | 12.6 | 12.3 | 14 | 3 | Scald on sprayed and un- sprayed. Sprayed: severe breakdown. Unsprayed: incipient |
| | | | 60 | 4 | 3¼ to 4 (60%:4; 40%: 3½) | 5.6 | 13.1 | 12.6 | 12.0 | 28 | 3 | Scald more severe on sprayed |
| | | | 40 | 3 to 4+ (64%:4 to 4+; 12%:3 to 3½) | 2½ to 4+ (25%:4 to 4+; 53%:3 to 3½) | 3.3 | 7.1 | 12.2 | 12.2 | 24 | 2 | Scald on sprayed and un- sprayed |
| | | | 60 | 4 to 4+ | 4 to 4+ | 3.4 | 4.9 | 12.2 | 12.0 | 54 | 9 | Breakdown complete in sprayed. Scald on sprayed and unsprayed |
| R4 | August 21, last of crop..... | { 3 1 } | 40 | 4 to 4+ | 3½ to 4 | 3.0 | 6.2 | 12.8 | 13.0 | 37 | 9 | Breakdown complete in sprayed, moderate to se- vere in unsprayed. Scald on both |
| | | | 56 | 4+ | ..... | .... | .... | .... | .... | 86 | .. | Scald |

* Color range estimated by use of official color chart for standards of pear maturity: 1, green; 2, light green; 3, yellowish green; 4, yellow (greenish yellow); 4+, full yellow.
† Pressure represented by firmness in pounds determined by the U. S. Department of Agriculture pressure tester with a 5/16-inch plunger point.
‡ Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period; does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 5--(Continued)

| Ripening record | | | | | | | | | |
|-----------------|---------------------------------------|-----------------------------|--------------------------|-----------------|-------------------|---------------------------|-----------------------|--|-------------------------------|
| Code mark | Date of picking and stage of maturity | Delay after picking days | Storage at 32° F days | Ripening period | | Visible watery breakdown† | | Remarks | |
| | | | | Sprayed days | Unsprayed days | Sprayed per cent | Unsprayed per cent | | |
| | | | | | | | | | |
| RX | July 17, shipping..... | 1 | 40 | 5 | 5 | 0 | 0 | Sprayed and unsprayed pears in good condition | |
| R1 | July 25, early canning..... | { 1 1 3 3 | 40 | 5 | 5 | 0 | 0 | ..... |  |
| | | | 60 | 4 | 5 | 0 | 0 | Sprayed, 98%: 4 to 4+; unsprayed, 50%: 4 to 4+ | |
| | | | 40 | 4 | 4 | 0 | 0 | ..... |  |
| | | | 60 | 3 | 4 | 0 | 0 | Sprayed, more yellow | |
| | | | | 4 | 4 | 1 | 1 | 4 | Sprayed, slightly more yellow |
| R2 | August 8, midseason canning.... | { 1 1 3 3 | 40 | 3 | 4 | 3 | 3 | ..... |  |
| | | | 60 | 3 | 3 to 4 | 7 | 3 | Irregular ripening | |
| | | | 40 | 1 | 1 | 6 | 5 | ..... |  |
| | | | 60 | 2 | 2 | 14 | 3 | Severe watery breakdown | |
| | | | 60 | 3 | 4 | 30 | 3 | | |
| R3 | August 15, late canning..... | { 1 3 3 | 40 | 2 | 3 | 24 | 2 | Severe watery breakdown | |
| | | | 60 | 1 | 3 | 54 | 11 | | |
| | | | | 0 | 2 | 37 | 9 | | |
| R4 | August 21, last of crop..... | 3 | 40 | | | | | Severe watery breakdown | |

| After-ripening record | | | | | | | | | | | | | |
|-----------------------|---------------------------------------|---------------------|------------------|----------------|------------|---------------------------|------------|--------------------|------------|-----------------|------------|--|------|
| Code mark | Date of picking and stage of maturity | Delay after picking | Storage at 32° F | After ripening | | Visible watery breakdown† | | Internal breakdown | | Total breakdown | | Remarks | |
| | | | | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | | |
| | | | | | | | | | | | | | days |
| RX | July 17, shipping..... | 1 | 40 | 6 | 6 | 0 | 0 | 95 | 100 | 95 | 100 | Some pears with brown calyx area | |
| R1 | July 25, early canning..... | { | 40 | 5 | 5 | 0 | 0 | 97 | 100 | 97 | 100 | Some pears with brown calyx area | |
| | | | 60 | 5 | 5 | 0 | 0 | 92 | 90 | 92 | 90 | ..... |  |
| | | | 40 | 5 | 5 | 0 | 0 | 91 | 95 | 91 | 95 | Some pears with brown calyx area | |
| | | | 60 | 5 | 5 | 0 | 0 | 94 | 96 | 94 | 96 | Some pears with brown calyx area. No watery breakdown after 9 days | |
| R2 | August 8, midseason canning | { | 40 | 3 | 3 | 1 | 1 | 88 | 83 | 89 | 84 | Beginning of watery breakdown | |
| | | | 60 | 5 | 5 | 6 | 4 | 89 | 95 | 95 | 99 | | |
| | | | 40 | 4 | 4 | 7 | 3 | 73 | 67 | 80 | 70 | | |
| | | | 60 | 6 | 6 | 9 | 8 | 58 | 84 | 67 | 93 | | |
| R3 | August 15, late canning..... | { | 40 | 5 | 5 | 67 | 34 | 33 | 62 | 100 | 96 | Severe watery breakdown | |
| | | | 60 | 3 | 5 | 51 | 51 | 42 | 49 | 93 | 100 | | |
| | | | 40 | 5 | 4 | 88 | 29 | 10 | 47 | 98 | 75 | | |
| | | | 60 | 2 | 3 | 69 | 16 | 11 | 67 | 80 | 83 | | |
| R4 | August 21, last of crop..... | 3 | 40 | 5 | 5 | 61 | 47 | 14 | 33 | 75 | 80 | Severe watery breakdown | |

† Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period; does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

| | | | | | | | | | | | | | |
|----|---|---|----|---------|--|---------|------|------|------|------|----|---|---|
| S2 | August 17, midseason canning..... | 1 | 40 | 2 to 3½ | | 2 to 3½ | 10.8 | 11.1 | 11.0 | 11.8 | 0 | 0 | Sprayed, slightly more color |
| | | 1 | 60 | 2½ to 4 | | 2½ to 4 | 11.2 | 9.6 | 10.4 | 10.8 | 1 | 0 | Sprayed, higher percentage of no. 4 color; pressure variable |
| | | 3 | 40 | 3½ to 4 | | 2½ to 4 | 3.2 | 3.5 | 11.4 | 11.8 | 5 | 5 | Sprayed, canning ripe; un- sprayed mostly so. Un- sprayed mostly 3 to 3½ color |
| | | 3 | 60 | 3½ to 4 | | 3½ to 4 | 3.2 | 3.9 | 10.8 | 11.1 | 51 | 6 | Canning ripe; scald |
| S3 | August 28, late can- ning; last of crop... | 1 | 40 | 3 to 4 | | 3 to 4 | 5.7 | 4.8 | 11.6 | 12.2 | 13 | 9 | Mostly canning ripe; un- sprayed, mostly 4; un- sprayed, mostly 3½ |

* Color range estimated by use of official color chart for standards of pear maturity: 1, green; 2, light green; 3, yellowish green; 4, yellow (greenish yellow); 4+, full yellow.
† Pressure represented by firmness in pounds determined by the U. S. Department of Agriculture pressure tester with a 5/16-inch plunger point.
‡ Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period; does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 6—(Continued)

| Ripening record | | | | | | | | | |
|-----------------|--|---------------------|------------------|-----------------|-----------|---------------------------|-----------|---|--|
| Code mark | Date of picking and stage of maturity | Delay after picking | Storage at 32° F | Ripening period | | Visible watery breakdown† | | Remarks | |
| | | | | Sprayed | Unsprayed | Sprayed | Unsprayed | | |
| | | days | days | days | days | per cent | per cent | | |
| S1 | August 3, early canning..... | { 1 1 3 3 1 1 3 } | 40 | 4 | 4 | 0 | 0 | Sprayed pears more yellow, and ripening irregular | |
| | | | 60 | 2 to 3 | 3 | 0 | 0 | Sprayed pears more yellow, and ripening irregular | |
| | | | 40 | 4 | 4 | 0 | 0 | Sprayed more yellow; ripening irregular in both lots | |
| | | | 60 | 3 to 4 | 3 to 4 | 0 | 0 | Sprayed more yellow; ripening irregular in both lots | |
| | | | 40 | 2 | 2 | 0 | 0 | Sprayed and unsprayed pears very similar in color | |
| | | | 60 | 3 | 3 | 1 | 0 | ..... |  |
| S2 | August 17, midseason canning.... | { } | 40 | 0 | 1 | 5 | 5 | Sprayed slightly more advanced in maturity; watery breakdown out of storage | |
| | | | 60 | 0 | 1 | 51 | 6 | Sprayed slightly more advanced in maturity; watery breakdown out of storage | |
| S3 | August 28, late canning; last of crop..... | 1 | 40 | 1 | 1 | 22 | 9 | Watery breakdown | |

| After-ripening record | | | | | | | | | | | | |
|-----------------------|--|---------------------|------------------------|----------------|------------|---------------------------|------------|--------------------|------------|-----------------|------------|--|
| Code mark | Date of picking and stage of maturity | Delay after picking | Storage at 32° F | After ripening | | Visible watery breakdown† | | Internal breakdown | | Total breakdown | | Remarks |
| | | | | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | |
| | | | | | | | | | | | | |
| S1 | August 3, early canning..... | { 1 1 3 3 | { 40 60 40 60 | 3 | 3 | 0 | 0 | 94 | 86 | 84 | 86 | No watery breakdown |
| | | | | 4 to 5 | 4 | 2 | 2 | 96 | 94 | 98 | 96 | Slight watery breakdown |
| | | | | 3 | 3 | 0 | 0 | 72 | 70 | 72 | 70 | No watery breakdown |
| | | | | 4 | 4 | 0 | 2 | 58 | 82 | 58 | 84 | Slight watery breakdown in unsprayed lot |
| S2 | August 17, midseason canning..... | { 1 1 3 3 | { 40 60 40 60 | 3 | 3 | 14 | 8 | 32 | 56 | 46 | 64 | Watery breakdown |
| | | | | 4 | 4 | 20 | 21 | 80 | 79 | 100 | 100 | Severe watery breakdown |
| | | | | 3 | 2 | 73 | 20 | 21 | 27 | 94 | 48 | Severe watery breakdown |
| | | | | 0 | 3 | 51 | 37 | 26 | 52 | 77 | 89 | Severe watery breakdown |
| S3 | August 28, late canning; last of crop..... | 1 | 40 | 3 | 3 | 37 | 15 | 17 | 19 | 54 | 34 | Severe watery breakdown |

† Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period; does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 7

HORMONE SPRAYS IN RELATION TO RIPENING AND BREAKDOWN OF BARTLETT PEARS, LAKE COUNTY, 1944

| Harvesting record | | | | | | | | | | |
|-------------------|--|--------------|-----------|-----------|-----------|----------------|-----------|---|-----------|-----------|
| Code mark | Locality, date of picking, and stage of maturity | Color range* | | Pressure† | | Soluble solids | | Remarks | | |
| | | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | | | |
| | | | | | | | | | color no. | color no. | pounds | pounds | per cent | per cent |
| L1 | Kelseyville: August 10, early canning | 2 | 2 | 19.2 | 19.5 | 11.2 | 11.0 | Only a small percentage of pears of 2½ inches. Sprayed and unsprayed of equal color and firmness Sprayed and unsprayed of similar color and firmness Pears were 2¾ to 3 inches. Sprayed and unsprayed of equal color and firmness | per cent | per cent |
| L2 | August 24, midseason canning. | 2+ to 2½ | 2 to 2½ | 18.7 | 17.9 | 11.4 | 12.2 | | | |
| L3 | September 7, late canning; last of crop | 2½ to 3 | 2½ to 3 | 16.3 | 16.0 | 12.2 | 12.8 | | | |
| A1 | Finley: August 11, early canning | 2 | 2 | 19.6 | 19.3 | 12.4 | 13.0 | Pears were 2½ inches. No maturity differences in sprayed or unsprayed | | |
| A2 | August 24, midseason canning. | 2½ | 2½ to 3 | 18.7 | 17.9 | 12.6 | 13.6 | Unsprayed of slightly higher color and less firm than sprayed. (Fruit from individual trees only) | | |
| A3 | September 8, late canning; last of crop | 3 | 3 to 3½ | 17.8 | 17.1 | 13.4 | 14.0 | Unsprayed of slightly higher color and less firm than sprayed. (Fruit from individual trees only) | | |

| Storage record | | | | | | | | | | |
|----------------|--|------------------------------|-------------------|---------------------|--------------------|-----------|-----------|----------------|-----------|--|
| Code mark | Date of picking and stage of maturity | Delay after picking | Storage at 32° F. | Color range* | | Pressure† | | Soluble solids | | Remarks |
| | | | | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | |
| | | | | | | | | | | |
| L1 | Kelseyville: August 10, early canning | days { 1 1 3 3 } | days | color no. | color no. | pounds | pounds | per cent | per cent | per cent |
| | | | 40 | 2 to 2½ (few 3) | 2½ to 3 (mostly 3) | 20.2 | 20.4 | 12.1 | 12.3 | 0 |
| | | | 60 | 3 to 3½ (mostly 3½) | ..... | 20.0 | .... | 11.0 | .... | 0 |
| | | | 40 | 2½ to 3 (uniform) | 2½ to 3 (uniform) | 16.4 | 16.9 | 12.2 | 12.3 | 0 |
| | | | 60 | 3 to 3½ (mostly 3½) | 3 to 4 (mostly 3½) | 14.0 | 8.8 | 12.2 | 11.8 | 0 |
| | | | | | | | | | | All pears hard and in good condition |
| | | | | | | | | | | All pears hard and in good condition |
| | | | | | | | | | | All pears hard and in good condition |
| | | | | | | | | | | A few unsprayed pears of more color than sprayed |

| | | | | | | | | | | | | |
|----|--|--------------------|----------------------|--|--|--------------------------|---------------------------|------------------------------|------------------------------|------------------|-------------------|--|
| L2 | August 24, midseason canning..... | { 1 1 3 | 40 60 40 | 2½ to 3 3 to 3½ 3 to 4 (mostly 3½) | 2½ to 3 3 to 3½ 3 to 4 (mostly 3½) | 16.1 17.0 12.5 | 15.2 16.8 9.7 | 12.5 12.4 13.2 | 13.0 12.2 12.8 | 0 0 0 | 0 0 1 | Color of sprayed and unsprayed similar Sprayed of slightly more color Sprayed and unsprayed more yellow than fruit delayed only 1 day |
| L3 | September 7, late canning; last of crop..... | { 1 1 3 | 40 60 60 | 3½ to 4 3½ to 4 (mostly 3½) 4 | 3½ to 4 3 to 4 (mostly 3½) 3½ to 4 | 10.9 10.7 11.2 | 10.5 13.4 12.5 | 11.9 11.8 12.6 | 12.4 12.8 13.0 | 0 0 1 | 0 0 0 | Sprayed and unsprayed hard and sound Sprayed and unsprayed show scald. Sprayed of more color Sprayed and unsprayed showed scald |
| A1 | Finley: August 11, early canning..... | 3 | 60 | 3½ to 4 (mostly 3½) | 3½ to 4 (mostly 3½) | 11.7 | 13.8 | 12.9 | 13.8 | 0 | 0 | Sprayed pears less yellow |
| A2 | August 24, midseason canning..... | { 3 3 | 40 60 | 3½ to 4 3½ | 3½ to 4 (mostly 4) | 8.2 7.0 | 8.0 5.1 | 13.8 13.0 | 14.2 13.7 | 0 0 | 0 2 | Color of sprayed and unsprayed similar Sprayed, less yellow |
| A3 | September 8, late canning; last of crop..... | { 1 1 3 3 | 40 60 40 60 | 3½ to 4 (mostly 3½) 4 3½ to 4 | 3½ to 4 (mostly 3½) 4 4+ | 9.7 8.2 6.9 8.4 | 8.9 10.4 4.5 7.4 | 13.4 13.7 14.0 13.8 | 14.2 15.6 14.0 15.2 | 0 1 0 3 | 0 7 7 10 | Unsprayed pears showed scald Pears delayed 3 days, more yellow |

* Color range estimated by use of official color chart for standards of pear maturity: 1, green; 2, light green; 3, yellowish green; 4, yellow (greenish yellow); 4+, full yellow.
† Pressure represented by firmness in pounds determined by the U. S. Department of Agriculture pressure tester with a 5/16-inch plunger point.
‡ Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period, does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 7—(Continued)

| Ripening record | | | | | | | | | |
|-----------------|---|---------------------|------------------|-------------------|-----------|---------------------------|------------|--|--|
| Code mark | Date of picking and stage of maturity | Delay after picking | Storage at 32° F | Ripening period | | Visible watery breakdown† | | Remarks | |
| | | | | Sprayed | Unsprayed | Sprayed | Unsprayed | | |
| | | | | | | | | | days | days | per cent | per cent |
| L1 | Kelseyville: | | | | | | | | |
| | August 10, early canning. | { 1 1 3 3 } | 40 60 40 60 | 4 5 to 6 4 4 to 5 | 4 .. 4 4 | 0 0 0 0 | 0 0 0 0 | Sprayed and unsprayed had slight scald | |
| | August 24, midseason canning | { 1 1 3 3 } | 40 60 40 60 | 4 4 2 3 | 4 4 2 3 | 0 0 0 3 | 0 0 1 0 | Unsprayed had slight scald | |
| | September 7, late canning; last of crop..... | { 1 1 3 3 } | 40 60 40 60 | 3 4 2 3 | 3 4 2 3 | 0 7 2 3 | 0 5 5 4 | Scald greater on sprayed and unsprayed than when just out of storage Scald greater on sprayed and unsprayed than when just out of storage | |
| A1 | Finley: August 11, early canning. | 3 | 60 | 4 | 4 | 0 | 0 | 0 | |
| A2 | August 24, midseason canning. | { 3 3 } | 40 60 | 3 4 | 3 3 | 0 0 | 0 2 | 0 2 | Some scald on sprayed and unsprayed |
| A3 | September 8, late canning; last of crop..... | { 1 1 3 3 } | 40 60 40 60 | 4 4 3 3 | 3 4 2 3 | 0 2 1 4 | 6 12 10 11 | Some scald on sprayed and unsprayed | |

After-ripening record

| Code mark | Date of picking and stage of maturity | Delay after picking | Storage at 32° F. | After ripening | | Visible watery breakdown† | | Internal breakdown | | Total breakdown | | Remarks |
|-----------|--|--------------------------------------|-------------------|----------------|------------|---------------------------|------------|--------------------|------------|-----------------|---|---------|
| | | | | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | |
| | | | | | | | | | | | | |
| L1 | Kelseyville: August 10, early canning... | { 1 1 3 3 1 1 } | days | days | | | per cent | per cent | per cent | per cent | per cent | |
| | | | 40 | 5 | 0 | 0 | 86 | 96 | 86 | 96 | Calyx browning: sprayed, 12%; unsprayed, 4% | |
| | | | 60 | 4 | 0 | 0 | 90 | .. | 90 | .. | Calyx browning: sprayed, 10%; unsprayed, — | |
| | | | 40 | 5 | 0 | 0 | 94 | 96 | 94 | 96 | Calyx browning: sprayed, 8%; unsprayed, 0 | |
| | | | 60 | 5 | 0 | 0 | 100 | 100 | 100 | 100 | Calyx browning: sprayed, 6%; unsprayed, 10% | |
| | | | 40 | 5 | 0 | 0 | 95 | 78 | 95 | 78 | ..... |  |
| L2 | August 24, midseason canning..... | { 3 3 1 1 } | 60 | 5 | 0 | 0 | 93 | 96 | 93 | 96 | Watery breakdown 10 days after ripening in sprayed and unsprayed; unsprayed, some mealy pears | |
| | | | 40 | 6 | 0 | 2 | 92 | 97 | 92 | 99 | ..... |  |
| | | | 60 | 5 | 9 | 0 | 90 | 99 | 99 | 99 | Watery breakdown with scald: sprayed, 5 days after ripening; unsprayed, 10 days after ripening | |
| | | | 40 | 5 | 3 | 0 | 93 | 96 | 96 | 96 | Watery breakdown 10 days after ripening in sprayed and unsprayed | |
| | | | 60 | 5 | 22 | 7 | 77 | 93 | 99 | 100 | ..... |  |
| | | | 40 | 6 | 2 | 10 | 95 | 90 | 97 | 100 | Watery breakdown 11 days after ripening in over 50% of sprayed and unsprayed | |
| L3 | September 7, late canning; last of crop..... | { 3 3 3 1 } | 60 | 5 | 9 | 10 | 91 | 90 | 100 | 100 | Watery breakdown 11 days after ripening in over 50% of sprayed and unsprayed | |
| | | | 60 | 5 | 0 | 0 | 100 | 100 | 100 | 100 | Watery breakdown in several sprayed and unsprayed 10 days after ripening | |
| | | | 40 | 6 | 8 | 4 | 91 | 78 | 99 | 82 | ..... |  |
| | | | 60 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | Watery breakdown 10 days after ripening, about 75% in both sprayed and unsprayed; more scald in unsprayed | |
| | | | 40 | 4 | 0 | 8 | 90 | 75 | 90 | 83 | Watery breakdown 10 days after ripening: sprayed, 65%; unsprayed, 90% | |
| | | | 60 | 5 | 9 | 21 | 85 | 70 | 94 | 91 | ..... |  |
| A1 | Finley: August 11, early canning... | { 3 3 } | 40 | 5 | 10 | 30 | 77 | 67 | 93 | 97 | Watery breakdown 10 days after ripening about 75% in sprayed and unsprayed | |
| | | | 60 | 5 | 16 | 30 | 77 | 67 | 93 | 97 | ..... |  |
| | | | 40 | 5 | 10 | 30 | 77 | 67 | 93 | 97 | ..... |  |
| | | | 60 | 5 | 16 | 30 | 77 | 67 | 93 | 97 | ..... |  |
| | | | 40 | 5 | 16 | 30 | 77 | 67 | 93 | 97 | ..... |  |
| | | | 60 | 5 | 16 | 30 | 77 | 67 | 93 | 97 | ..... |  |
| A2 | August 24, midseason canning..... | { 3 3 } | 40 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | ..... |  |
| | | | 60 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | ..... |  |
| | | | 40 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | ..... |  |
| | | | 60 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | ..... |  |
| | | | 40 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | ..... |  |
| | | | 60 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | ..... |  |
| A3 | September 8, late canning; last of crop..... | { 1 1 3 3 } | 40 | 4 | 0 | 8 | 90 | 75 | 90 | 83 | ..... |  |
| | | | 60 | 5 | 9 | 21 | 85 | 70 | 94 | 91 | ..... |  |
| | | | 40 | 5 | 10 | 21 | 63 | 72 | 73 | 93 | ..... |  |
| | | | 60 | 5 | 16 | 30 | 77 | 67 | 93 | 97 | ..... |  |
| | | | 40 | 5 | 16 | 30 | 77 | 67 | 93 | 97 | ..... |  |
| | | | 60 | 5 | 16 | 30 | 77 | 67 | 93 | 97 | ..... |  |

† Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period, does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 8
HORMONE SPRAYS IN RELATION TO RIPENING AND BREAKDOWN OF MEDIUM-SIZED AND LARGE BARTLETT PEARS, 1944

| Harvesting record | | | | | | | | | |
|-------------------|---------------------------------------|----------------------|--------------|-----------|-----------|-----------|----------------|-----------|--|
| Code mark | Locality and date of picking | Size | Color range* | | Pressure† | | Soluble solids | | Remarks |
| | | | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | |
| | | | color no. | color no. | pounds | pounds | per cent | per cent | |
| R2 | Sacramento River: August 8..... | { Medium Large | 2+ to 2½ | 2+ | 15.6 | 16.5 | 12.2 | 12.0 | ..... |
| | | | 2½ | 2½ | 16.0 | 17.4 | 12.2 | 11.4 | Large pears of more color but firmer |
| R3 | August 15..... | { Medium Large | 2½ to 4 | 2 to 3 | 15.7 | 17.4 | 12.9 | 12.4 | ..... |
|  |  |  | .... | .... | 16.4 | .... | 12.4 | .... | ..... |
| R4 | August 21..... | { Medium Large | .... | 2½ to 3 | .... | 15.4 | .... | 12.8 | ..... |
| | | | 3 to 3½ | 2½ to 3 | 14.4 | 17.4 | 13.2 | 11.8 | ..... |
| | Averages..... | { Medium Large | .... | .... | 15.6 | 16.0 | 12.6 | 12.4 | ..... |
|  |  |  | .... | .... | 16.2 | 17.4 | 12.3 | 11.6 | ..... |
| S2 | Santa Clara Valley: August 19..... | { Medium Large | 1½ to 2 | 1½ to 2 | 16.7 | 17.4 | 11.0 | 11.7 | ..... |
| | | | 2 | 2 | 17.3 | 17.7 | 11.7 | 11.6 | Large pears of more color but firmer |
| A2 | Finley: August 24..... | { Medium Large | 2½ | 2½ to 3 | 18.7 | 17.9 | 12.6 | 13.6 | Some large pears of less color and slightly softer than the medium |
| | | | 2 to 2½ | 2½ to 3 | 16.6 | 17.5 | 14.0 | 13.6 | ..... |

Storage record

| Code mark | Locality and date of picking | Size | Delay after picking | Storage at 32° F | Color range* | | Pressure† | | Soluble solids | | Visible watery breakdown‡ | | Remarks |
|-----------|---------------------------------------|------------------|---------------------|------------------|--------------------|---------------------|----------------|--------------|----------------|--------------|---------------------------|-------------|---|
| | | | | | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | Sprayed | Unsprayed | |
| | | | | | color no. | color no. | pounds | pounds | per cent | per cent | per cent | per cent | |
| R2 | Sacramento River: August 8..... | {Medium Large | days 1 1 | days 40 40 | 3 to 3½ 3 to 3½ | 3 to 3½ 3 to 3½ | 14.2 14.0 | 15.1 14.7 | 13.0 13.0 | 12.9 12.9 | 1 0 | 0 6 | Breakdown on neck of pears |
| | | | | | | | | | | | | | |
| R3 | August 15..... | {Medium Large | 3 3 | 40 40 | 3 to 4+ 3½ to 4 | 2½ to 4+ 3½ to 4 | 3.3 4.1 | 7.1 4.4 | 12.2 12.4 | 12.2 12.6 | 24 9 | 2 10 | Unsprayed pears more yellow |
| | | | | | | | | | | | | | |
| R4 | August 21..... | {Medium Large | 3 3 | 60 60 | 4 to 4+ 4 to 4+ | 4 to 4+ 4 to 4+ | 3.4 3.1 | 4.9 3.3 | 12.2 13.4 | 12.0 13.4 | 54 61 | 9 21 | Breakdown more complete on sprayed; scald on unsprayed |
| | | | | | | | | | | | | | |
| | Averages..... | {Medium Large | .. .. | .. .. | ..... ..... | ..... ..... | ..... ..... | 6.2 3.3 | ..... ..... | 13.0 13.2 | ..... ..... | 9 22 | Breakdown moderate to severe |
| | | | | | | | | | | | | | |
| S2 | Santa Clara Valley: August 17..... | {Medium Large | 3 3 | 40 40 | 3½ to 4 3 to 4 | 2½ to 4 3 to 4 | 3.2 3.3 | 3.5 3.2 | 11.4 12.2 | 11.8 11.8 | 5 7 | 5 13 | {Watery breakdown in sprayed and unsprayed |
| | | | | | | | | | | | | | |
| | Averages..... | {Medium Large | 3 3 | 60 60 | 3½ to 4 3½ to 4 | 3½ to 4 3½ to 4 | 3.2 5.5 | 3.9 3.7 | 10.8 12.2 | 11.1 11.5 | 51 6 | 6 31 | {Increased watery breakdown and some scald |
| | | | | | | | | | | | | | |
| A2 | Finley: August 24..... | {Medium Large | .. .. | .. .. | ..... ..... | ..... ..... | 3.2 4.4 | 3.7 3.4 | 11.1 12.2 | 11.4 11.6 | 28.0 6.5 | 5.5 22.0 | ..... ..... |
| | | | | | | | | | | | | | |
| | Averages..... | {Medium Large | 3 3 | 40 40 | 3½ to 4 3 to 3½ | 3½ to 4 3½ to 4 | 8.2 8.8 | 8.0 7.7 | 13.8 13.0 | 14.2 14.2 | 0 0 | 0 0 | Sprayed and unsprayed pears similar in color Sprayed pears less yellow |
| | | | | | | | | | | | | | |
| | Averages..... | {Medium Large | 3 3 | 60 60 | 3½ 3½ | 3½ to 4 3½ to 4 | 7.0 9.0 | 5.1 6.6 | 13.0 12.6 | 13.7 13.8 | 0 0 | 2 0 | Sprayed pears sound, less yellow than unsprayed Sprayed pears firmer, less yellow than unsprayed |
| | | | | | | | | | | | | | |
| | Averages..... | {Medium Large | .. .. | .. .. | ..... ..... | ..... ..... | 7.6 8.9 | 6.5 7.1 | 13.4 12.8 | 13.9 14.0 | 0.0 0.0 | 1.0 0.0 | ..... ..... |
| | | | | | | | | | | | | | |

* Color range estimated by use of official color chart for standards of pear maturity: 1, green; 2, light green; 3, yellowish green; 4, yellow (greenish yellow); 4+, full yellow
† Pressure represented by firmness in pounds determined by the U. S. Department of Agriculture pressure tester with a 5/16-inch plunger point.
‡ Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period, does not include visible breakdown resulting from scald, bruising handling, or appearing as dry, brown areas at the calyx after ripening.

TABLE 8—(Continued)

| Ripening record | | | | | | | | | | |
|-----------------|---------------------------------------|----------------------|-----------------------------|--------------------------|-----------------|-------------------|---------------------------|-----------------------|--|--|
| Code mark | Locality and date of picking | Size | Delay after picking days | Storage at 32° F days | Ripening period | | Visible watery breakdown† | | Remarks | |
| | | | | | Sprayed days | Unsprayed days | Sprayed per cent | Unsprayed per cent | | |
| | | | | | | | | | | |
| R2 | Sacramento River: August 8..... | { Medium Large | 1 1 | 40 40 | 4 3 | 4 3 | 1 1 | 1 6 | Large pears more yellow than medium-sized Large pears more yellow than medium-sized | |
| R3 | August 15..... | { Medium Large | 3 3 | 40 40 | 2 2 | 3 1 | 24 9 | 2 10 | More breakdown in medium-sized pears than in large | |
| R4 | August 21..... | { Medium Large | 3 3 | 40 40 | .. .. | 2 0 | .. .. | 9 22 | ..... ..... ..... ..... |  |
| | Averages..... | { Medium Large | .. .. | .. .. | 2.3 1.7 | 3.0 1.0 | 26.3 23.7 | 5.8 14.8 | ..... ..... |  |
| S2 | Santa Clara Valley: August 17..... | { Medium Large | 3 3 | 40 40 | 0 0 | 1 0 | 5 7 | 5 13 | Watery breakdown in both large- and medium-sized pears | |
| | | { Medium Large | 3 3 | 60 60 | 0 1 | 1 1 | 51 9 | 6 31 | Watery breakdown severe in sprayed pears; some scald Watery breakdown severe in unsprayed pears; some scald | |
| | Averages..... | { Medium Large | .. .. | .. .. | 0.0 0.5 | 1.0 0.5 | 28.0 8.0 | 5.5 22.0 | ..... ..... |  |
| A2 | Finley: August 24..... | { Medium Large | 3 3 | 40 40 | 3 4 | 3 3 | 0 0 | 0 0 | ..... ..... |  |
| | | { Medium Large | 3 3 | 60 60 | 4 4 | 3 4 | 0 0 | 2 0 | Scald on sprayed and unsprayed pears Scald on unsprayed pears | |
| | Averages..... | { Medium Large | .. .. | .. .. | 3.5 4.0 | 3.0 3.5 | 0.0 0.0 | 1.0 0.0 | ..... ..... |  |

After-ripening record

| Code mark | Locality and date of picking | Size | Delay after picking | Storage at 32° F | After ripening | | Visible watery breakdown† | | Internal breakdown | | Total breakdown | | Remarks | |
|-----------|------------------------------------|----------------------|---------------------|------------------|----------------|------------|---------------------------|------------|--------------------|------------|-----------------|------------|--|-------|
| | | | | | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | Sprayed | Un-sprayed | | |
| R2 | Sacramento River: August 8..... | { Medium Large | 1 | 40 | 3 | 3 | 1 | 1 | 88 | 83 | 89 | 84 | ..... |  |
| | | | 1 | 40 | 4 | 4 | 1 | 8 | 84 | 79 | 85 | 87 | ..... |  |
| | | { Medium Large | 3 | 40 | 5 | 4 | 88 | 28 | 10 | 47 | 98 | 75 | ..... |  |
| | | | 3 | 40 | 3 | 3 | 26 | 44 | 29 | 28 | 55 | 72 | ..... |  |
| R3 | August 15..... | { Medium Large | 3 | 60 | 2 | 3 | 69 | 16 | 11 | 67 | 80 | 83 | ..... |  |
| | | | 3 | 60 | 5 | 5 | 79 | 43 | 15 | 23 | 94 | 66 | ..... |  |
| | | { Medium Large | 3 | 40 | .. | 5 | .. | 47 | .. | .. | 33 | .. | 80 | |
| | | | 3 | 40 | .. | 5 | .. | 43 | .. | .. | 35 | .. | 78 | |
| R4 | August 21..... | { Medium Large | .. | .. | 3.3 | 3.8 | 52.3 | 23.0 | 36.3 | 57.5 | 89.0 | 80.5 | Total breakdown in medium-sized pears greater than in large | |
| | | | .. | .. | 4.0 | 4.2 | 35.3 | 34.5 | 42.7 | 41.2 | 78.0 | 75.8 | | |
| | | { Medium Large | 3 | 40 | 3 | 2 | 73 | 20 | 21 | 27 | 94 | 48 | | |
| | | | 3 | 40 | 3 | 3 | 35 | 56 | 23 | 32 | 58 | 88 | | |
| S2 | August 17..... | { Medium Large | 3 | 60 | 0 | 3 | 51 | 37 | 26 | 52 | 77 | 89 | ..... |  |
| | | | 3 | 60 | 2 | 0 | 21 | 31 | 19 | 27 | 40 | 68 | ..... |  |
| | | { Medium Large | .. | .. | 1.5 | 2.5 | 62.0 | 28.5 | 23.5 | 29.5 | 84.5 | 68.5 | Breakdown greater in sprayed, medium-sized pears than in large | |
| | | | .. | .. | 2.5 | 1.5 | 28.0 | 43.5 | 21.0 | 24.5 | 46.0 | 78.0 | | |
| A2 | Finley: August 24..... | { Medium Large | 3 | 40 | 6 | 6 | 8 | 4 | 91 | 78 | 99 | 82 | ..... |  |
| | | | 3 | 40 | 5 | 5 | 5 | 13 | 88 | 84 | 93 | 97 | ..... |  |
| | | { Medium Large | 3 | 60 | 5 | 5 | 15 | 2 | 81 | 90 | 96 | 92 | ..... |  |
| | | | 3 | 60 | 5 | 5 | 3 | 15 | 94 | 85 | 97 | 100 | ..... |  |
| | Averages..... | { Medium Large | .. | .. | 5.5 | 5.5 | 11.5 | 3.0 | 86.0 | 84.0 | 97.5 | 87.0 | No consistent difference between large- and medium-sized pears | |
| | | | .. | .. | 5.0 | 5.0 | 4.0 | 14.0 | 91.0 | 84.5 | 95.0 | 98.5 | | |

† Percentage of visible watery breakdown is cumulative; includes breakdown occurring in storage period, does not include visible breakdown resulting from scald, bruising, handling, or appearing as dry, brown areas at the calyx after ripening.

